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RULES AND DIRECTIVES BRANCH USNRC

Michael Lesar
Chief, Rulemaking and Directives Branch
U.S. Nuclear Regulatory Commission
Mail Stop TWB-05-B01
Washington, D.C.20555-0001

RE: Comments on Nichols Ranch SEIS, NUREG-1910, Supplement 2; Docket ID NRC 2008-0339

Dear Mr. Lesar:

On behalf of the Southwest Research and Information Center ("SRIC"), please accept the following comments on U.S. Nuclear Regulatory Commission's ("NRC's") supplemental environmental impact statement ("SEIS") to the Generic Environmental Impact Statement for *in situ leach* ("ISL") uranium mining, NUREG-1910 ("GEIS"), for the proposed Nichols Ranch ISL project.

I. Introduction

On July 24, the U.S. Nuclear Regulatory Commission published a Notice of Intent to publish a Generic Environmental Impact Statement for Uranium Milling Facilities in the Federal Register. 72 Fed. Reg. 40,344 (July 24, 2007). The purported purpose of the GEIS is to assess the potential "generic" impacts of ISL milling in the "western United States" as well as the impacts of alternative methods of uranium recovery, including conventional milling. *Id.* at 40,444 – 40,345. The Draft GEIS was issued on July 28, 2008. *Notice of Availability of Draft*

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Reg. 43,795 (July 28, 2008). SRIC submitted comments on the scope of the GEIS (SRIC Scoping Comments, Nov. 30, 2007) and the Draft GEIS (SRIC Comments on Draft GEIS, Nov. 7 2008), and incorporates those comments by reference herein. The NRC issued a notice of availability of a series of supplements to the GEIS, including the Nichols Ranch SEIS, in December of 2009. *Notice of Availability of Draft Environmental Impact Statement for the Nichols Ranch In-Situ Recovery (ISR) Project in Campbell and Johnson Counties, WY; Supplement to the Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities*, 74 Fed. Reg. 65,808 (Dec. 11, 2009). The following comments are intended to address both shortcomings in the Nichols Ranch SEIS and the GEIS.[1]

II. Alternatives Analysis is Inadequate

A. The Purpose and Need Statement Unreasonably Limits Alternatives Considered.

An agency's analysis of alternatives to a proposed project is at the heart of NEPA, and as such, the alternatives considered must be reasonable. An agency may not unreasonably limit the scope of alternatives considered, by unreasonably narrowing the agency's stated objective. The statement of purpose and need in the GEIS is so limiting that any subsequent statement of purpose and need in a supplemental EIS, in this case the Nichols Ranch SEIS, will inevitably be too narrow to allow for consideration of a reasonable range of alternatives.

The GEIS's statement of purpose and need provides:

> Commercial uranium recovery companies have approached NRC with plans to submit as many as 15 license applications for new uranium recovery facilities, as well as up to 9 applications for the restart or expansion of existing facilities in the next several years. The majority of these potential applications (perhaps 18 of the

[1] Additional comments on the GEIS are appropriate in this case because prior to its application to the Moore Ranch, Nichols Ranch, and Lost Creek projects, the GEIS was a purely theoretical and abstract document. The GEIS did not apply to any Federal plan or project and did not represent any final NRC regulatory or policy decision. The GEIS did not establish any specific rights or obligations and the NRC did not issue a record of decision on the GEIS. Thus, it was impossible for SRIC or any other member of the public to meaningfully comment on the GEIS in a concrete context.

> 24) would involve use of the ISL process. The companies have indicated that these new, restarted, and expanded ISL facilities would be located in Wyoming, South Dakota, Nebraska and New Mexico.
>
> NRC is the regulatory authority responsible for issuing a source material license for ISL facilities in those four states. 10 CFR Part 51 regulations require evaluating the environmental impacts of the ISL facility as part of the licensing process. Recognizing that the technology for ISL uranium milling is relatively standardized, that the applications may be submitted over a relatively short period of time, and that the potential ISL facilities would be located in relatively discrete regions of the western United States, NRC decided to prepare a GEIS to avoid unnecessary duplicative efforts and to identify environmental issues of concern to focus on in site-specific environmental reviews. In this way, NRC could increase the efficiency and consistency in its site-specific environmental review of license applications for ISL facilities and so provide an option for applicants to use and licensees to continue to use the ISL process for uranium recovery.
>
> .....
>
> NRC has concluded that it is not appropriate to determine the purpose and need for a site-specific license application in the GEIS.

GEIS at 1-5, citations omitted.

While purporting to defer any determination for site-specific purposes and needs, the GEIS in reality frames the purpose and need for subsequent supplemental EISs. The GEIS frames its purpose and need in unreasonably narrow terms, limiting the alternatives that the NRC will consider in the context of its stated objective, i.e., licensing ISL uranium operations. The statement of purpose and need in the GEIS serves to narrow the alternatives the NRC will consider to either 1) granting an ISL operation license application as proposed or 2) no action. Indeed, the NRC Staff has interpreted the GEIS's statement of purpose and need in exactly these terms. *See*, http://www.nrc.gov/materials/uranium-recovery/geis/alternative-eval.html. A copy of that webpage is attached hereto as Attachment A. Moreover, in reality, limiting the purpose and need scope to these two alternatives, effectively means that only one alternative – licensing

an ISL operation – is given serious consideration, since the NRC has **never** denied a materials license application in its institutional history.

As would be expected given the GEIS's narrow purpose and need scope, the NRC has defined the Nichols Ranch project purpose and need unreasonably narrowly. In the Nichols Ranch SEIS, the NRC has defined the scope of the project's purpose and need as "to provide an option that allows for the applicant to use ISR technology to recover uranium and produce yellowcake at the Nichols Ranch ISR Project site." SEIS at § 1.3, p. 1-1.

On its face, this statement of purpose and need unreasonably truncates the universe of alternatives the NRC can consider in the SEIS by forcing the federal action into three pigeonholes: 1) uranium recovery; 2) using ISL technology at 3) the Nichols Ranch site, which includes the Nichols Ranch Unit and the Hank Unit. In essence, the NRC is limiting the alternatives it will consider, as it did in the GEIS, to either licensing the proposed project or not licensing it. By limiting the scope of the major Federal action, the NRC has eliminated a range of reasonable alternatives that could - and should - be considered[2]. Such a truncated alternatives analysis violates both the letter and spirit of NEPA. The NRC should re-evaluate the alternatives analyses in both the GEIS and the Nichols Ranch SEIS.

B. The Alternatives Analysis Itself is Inadequate.

Notwithstanding the fact that the statement of purpose and need unreasonably limits which alternatives the NRC considered, the SEIS's alternatives analysis itself is inadequate. The NRC limited its alternatives analysis in the SEIS to three analyses: the proposed action, consisting of licensing ISL operations and the Nichols Ranch Unit and the Hank Unit (SEIS at §

[2] If the NRC had articulated a reasonable and legitimate purpose and need, the range of alternatives considered would likewise have been reasonable. For example, if the NRC had articulated a purpose and need of extracting uranium as fuel for domestic and foreign nuclear power plants as a way to provide electricity, then it - and the public - could have analyzed alternatives such as using renewable resources to meet electricity demand, extracting uranium from more appropriate locations, or whether there was a market need for uranium extraction at all.

2.1.1, pp. 2-1 – 2-26); the nearly identical alternative of licensing ISL operations at the Nichols Ranch Unit only (SEIS at § 2.1.3, pp. 2-26 – 2-27); and the "no action" alternative (SEIS at § 2.1.2, p. 2-26). The NRC eliminated from consideration the alternatives of conventional mining and milling, heap leaching, using alternative lixiviants and alternative methods of waste disposal. SEIS at § 2.2, pp. 2-27 – 2-29.

While NEPA does not require the NRC to consider every possible alternative to the proposed action, it does require that the NRC consider all reasonable alternatives. The NRC fails to do this in its SEIS. For example, while the NRC considers the alternative of not licensing the Hank Unit, it does not consider the reasonable alternative of not licensing the Nichols Ranch Unit. The alternative of not licensing the Nichols Ranch Unit is imminently reasonable because the Nichols Ranch Unit environmental impacts are significant, particularly the potential impacts on ground and surface water. The Nichols Ranch Unit is near Cottonwood Creek, which is an ephemeral water course, and its associated alluvial aquifers. SEIS at 3-11, 3-14. Moreover, thousands of linear feet of ephemeral watercourses flow through the Nichols Ranch Unit (SEIS at 3-11) and Uranez intends to dig at least 15 production and injection wells in ephemeral watercourses on the Nichols Ranch Unit (SEIS at 4-17). Therefore, considering an alternative that excludes the Nichols Ranch Unit in order to mitigate surface water impacts would have been reasonable. Further, the proposed production aquifer is under artesian conditions, further complicating an already complex hydrological system. SEIS at 3-14. Considering an alternative where the Nichols Ranch Unit is not licensed would allow the NRC to fully consider options that would help preserve local water resources.

Another reasonable alternative the NRC failed to consider is altering the proposed project's boundaries in order to reduce its environmental impacts. For example, the Nichols

Ranch Unit's boundaries could be altered such that no production occurs in the southern portion of the unit where mining is likely to contaminate surface waters and shallow groundwater. SEIS, § 4.5.2.1.2.1, pp. 4-23 – 4-24. Likewise, the Hank Unit boundaries could be altered such that impacts on the Pumpkin Buttes traditional cultural property are eliminated. *See, e.g.*, SEIS Figure 2-3, p. 2-4. By failing to consider these, and potentially other, reasonable alternatives, the NRC has violated NEPA.

III. The NRC Fails to Consider Impacts from and on Climate Change

The NRC determined that the combined effects of climate change and ISL mining would not be considered in the GEIS. GEIS at 1-15. The NRC adopted a similar position in the SEIS, choosing instead to turn a blind eye to the cumulative adverse impacts of the project and climate change because of what NRC characterized as "the imprecise state of the science" on climate change. SEIS at 5-12.

While the exact extent and timing of impacts of climate change may not be certain, many adverse impacts have already been documented and many more are reasonably certain to occur in the future as warming continues. *See, e.g.*, *Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act*, 74 FR 66496 (December 15, 2009). Moreover, as the recent Council on Environmental Quality Memorandum, attached hereto as Attachment B demonstrates, even though the science on climate change is rapidly evolving, federal agencies have an obligation to consider both the greenhouse gas emissions a federal action will contribute to the atmosphere and the impacts a federal action will have on natural resources impacted by climate change. Sutley, Nancy, Chair ,Council on Environmental Quality, Memorandum for Heads of Federal Departments and Agencies, *Draft*

NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions at 1 (Feb. 18, 2010) ("Draft NEPA GHG Guidance").

Further, as the attached document, SRIC's Attachment C, demonstrates, the effects of climate change on the region where the Nichols Ranch project is proposed can be reasonably anticipated. U.S. Global Change Research Program, *Global Climate Change Impacts in the United States, Regional Climate Impacts: Great Plains* at 123-128 (2009) ("Great Plains Report"); *see also* Draft NEPA GHG Guidance at 8. Attachment C clearly shows that depending on which region of Wyoming the Nichols Ranch project is located, climate change will affect the Nichols Ranch project's impacts and these impacts should be analyzed. If the Nichols Ranch project is in a region of Wyoming that can expect less snowpack and spring runoff and disruption of precipitation patterns over the next decades, as is expected to occur throughout the West, the NRC should disclose this and evaluate whether potable water sources outside the ore zone should be sacrificed [3] in exchange for extracting the mineral resource. If the Nichols Ranch project is in a region of Wyoming that could expect more precipitation over the next decades, the NRC should disclose that fact and evaluate how increased soil saturation, flooding and aquifer recharge would cumulatively interact with the Nichols Ranch project's impacts. A "hard look" analysis of the impacts of climate change, combined with the impacts of the Nichols Ranch project is critical, given that water is the most important factor affecting activities in the Great Plains region. Great Plains Report at 124; Draft NEPA GHG Guidance at 6-7.

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[3] The SEIS discloses that both the Nichols Ranch Unit and the Hank Unit have high quality groundwater outside the ore zone. SEIS at 3-19. Assuming the NRC does not allow Uranez to "restore" groundwater to alternative concentration limits, Uranez will only be required to restore groundwater to average baseline conditions within the wellfield, i.e., good quality groundwater outside the ore zone will be averaged with poor quality groundwater within the ore zone creating an overall poor quality groundwater baseline. Additionally, it is unlikely that Uranez will be able to restore groundwater to even those inflated standards, since no ISL operation has ever restored groundwater to pre-mining conditions. *See*, § IV.B., below.

The SEIS also does not fully disclose the impacts the mining operation will have on greenhouse gas emissions. The SEIS mentions how many greenhouse gas emissions the Nichols Ranch project is expected to generate in comparison to emissions generated at coal mines. SEIS at 5-13. However, this is an incomplete inventory of the greenhouse gas emissions that will result from the Nichols Ranch project. Before the yellowcake from the Nichols Ranch project can be used for fuel for a nuclear power plant, it must be converted to uranium hexafluoride, enriched and fabricated. *See, e.g.* World Nuclear Association, http://www.world-nuclear.org/info/inf03.html, last visited Feb. 23, 2101. These are indispensible processes if the uranium from the Nichols Ranch project will be used for nuclear fuel. These steps are also exceedingly energy intensive and rely on energy from carbon generating sources. Estimates for the carbon emissions generated in the nuclear fuel cycle range from 33 grams CO_2/kWh to 120 gr.CO_2/kWh , depending on uranium ore grade and other variables. Öko-Institut, *Comparison of Greenhouse Gas Emissions and Abatement Costs of Nuclear and Alternatives Energy Options from a Life-Cycle Perspective* at 4 (2006).[4] Since the uranium produced at the Nichols Ranch project would have no utility without being enriched and fabricated into fuel, the SEIS should have disclosed these carbon emissions and analyzed their impacts. Draft NEPA GHG Guidance at 2 ("it is appropriate for an agency to quantify and disclose its estimates of the expected annual direct and *indirect* GHG emissions in the environmental documentation for the proposed action.")(emphasis added).

[4] Available at http://www.oeko.de/publications/reports_studies/dok/659.php, last visited Feb. 23, 2010.

IV. The NRC's Water Resources Impact Analyses are Based on Inaccurate and Misleading Data

A. The NRC Misrepresents Spill Impacts in the GEIS and SEIS.

In evaluating the Nichols Ranch project's impacts on water resources, the NRC relies heavily on the survey of leaks and spills at ISL operations in the GEIS (§ 2.11.2) and the NRC Staff's memorandum, *Staff Assessment of Groundwater Impacts from Previously Licensed In-Situ Uranium Recovery Facilities,* ML091770187 (July 10, 2009). However, both these documents are incomplete or inaccurate. Moreover, the NRC's characterization of the data in these documents as used in both the GEIS and the SEIS is misleading. As a result, neither the GEIS, nor the Nichols Ranch project supplement to the GEIS are based on accurate data and therefore neither is sufficient under NEPA.

The attached data from the nearby Irigaray/Christensen Ranch ISL project show that over the project's operating history, there have been nearly 100 leaks and spills resulting in hundreds of thousands of gallons of contaminated water being dumped on the site. *See*, SRIC Attachment D. Even as recently as 2004, the Christensen Ranch project recorded a spill over 1000 gallons, and in 1999, it recorded a series of spills over three months totaling over 100,000 gallons. *Id.* at Table 1.2, # 81 and 63-68.

The spill history at the Irigaray/Christensen Ranch project is not an anomaly. In 1995, a surface estate owner in Texas sued ISL operator Uranium Resources, Inc. ("URI") for damages to his land from a series of spills at URI's Longoria Ranch project. A copy of the complaint in that law suit is attached hereto as Attachment E. There, the plaintiff alleged that URI's operations caused contamination of soils, ecosystems, ground and surface water due to spills and purposeful discharge of radioactive and hazardous contaminants. Attachment E at 3-5. The lawsuit subsequently settled.

The NRC, to a certain extent, acknowledges the abysmal record of spills and leaks at ISL operations. In the GEIS, the NRC notes that the Smith Ranch-Highland ISL operation , located within five miles of the proposed Nichols Ranch project, had more than 80 spills from 1988 to 2007. GEIS at 2-44. Some of these spills were as large as 198,500 gallons. *Id.* Indeed, the attached Wyoming Department of Environmental Quality Notice of Violation report (Attachment F) notes that spills, leaks and excursions at Smith Ranch – Highland had become "routine". Attachment F at p. 17.

However, rather than meaningfully evaluating the impacts of spills and leaks on water resources in the GEIS, the NRC simply makes sweeping pronouncements about the potential impacts, largely concluding that they will be small to moderate. *Id.* at 4.3-10 - 4.3-12. Moreover, the NRC concedes in the GEIS that a meaningful evaluation of impacts from spills and leaks is contingent on site-specific conditions. *See, e.g., Id.* at 4.3-12 ("Hence, potential environmental impacts due to spills and leaks from pipeline networks or failures of well integrity in shallow aquifers would be expected to be SMALL to MODERATE, depending on site-specific conditions.").

Rather than conducting the requisite NEPA site-specific analysis of reasonably foreseeable impacts from spills and leaks at the Nichols Ranch project, the NRC simply states that site-specific conditions at the Nichols Ranch project are consistent with the description of the affected environment described in the GEIS and concludes that the impacts from spills and leaks on surface waters would be small. SEIS at 4-18. The GEIS describes the **regional**, not local, affected environment which encompasses parts of seven counties within the so-called Wyoming East Milling Region. GEIS, Fig. 3.1-2 at 3.1-3. This general regional description of

the affected environment is no substitute for a meaningful description and analysis of the Nichols Ranch project's impacts on the local environment.

Additionally, this analysis disregards the close proximity of mining operations at Nichols Ranch to surface water sources such as Cottonwood Creek and several wetlands. *Id.* at 3-11 – 3-13. As a result, the NRC evades any meaningful analysis of impacts on surfaces waters by promising site-specific analyses in the GEIS, and then, when presented with the opportunity to engage in a site-specific analysis in the Nichols Ranch SEIS, simply incorporates the GEIS's analysis.

The NRC reaches a similar conclusion with respect to the impacts from spills and leaks on groundwater. SEIS at 4-24 and 4-27. In contrast to the evaluation of impacts from spills and leaks on surface water, the NRC considers site specific conditions in analyzing impacts from spills and leaks. *See generally*, *Id.* at § 4.5.2. However, the NRC's conclusion that impacts to groundwater from leaks and spills at the Nichols Ranch project will be small is just as unjustified as its conclusion about impacts on surface water. Again, the NRC's conclusion that impacts on groundwater from leaks and spills will be small rests on the assumption that Uranez will use effective mitigation measures. *Id.* at 4-23 – 4-24 ("However, the implementation of the leak detection program and mechanical integrity testing should mitigate the potential impact (i.e., early detection and cleanup) and result in SMALL potential operational impacts to shall (near surface) aquifers for the Nichols Ranch and Hank Units.").

As with its conclusions about the impacts from spills and leaks on surface waters, the NRC's conclusions about groundwater impacts completely disregard the operational history of all other ISL operations that have the same leak detection and well integrity programs as proposed for the Nichols Ranch project. The Smith Ranch-Highland project is illustrative. As

Attachment F demonstrates, one of the largest and oldest uranium ISL projects in Wyoming was found to have a disastrous history of leaks, spills and excursions, in addition to disregarding fundamental permit requirements. Attachment F, Moxley, Mark, Report of Investigation, Power Resources, Inc. at § 3 (Nov. 21, 2007). This fundamental contradiction between actual operational data and the NRC's conclusions about the magnitude of impacts in both the GEIS and the SEIS is contrary to NEPA.

B. The NRC Misrepresents the Impacts from Groundwater Restoration.

In both the GEIS and the Nichols Ranch SEIS, the NRC's conclusion that ground and surface water impacts will be small to moderate are premised on the assumptions that 1) groundwater restoration will be successful and 2) groundwater contaminated with radioactive elements and heavy metals will be contained within the production zone during operations and after restoration. Available data demonstrate that none of these assumptions are reasonable.

As with its analyses of water impacts from spills and leaks, the NRC mischaracterizes ISL mining's groundwater restoration efficacy history and unreasonably minimizes the impacts of groundwater restoration. NRC's failure to reasonably consider the impacts of groundwater restoration stems from two fundamental problems: (1) the NRC's practice of averaging poor groundwater quality with good groundwater quality to obtain "baseline" groundwater quality conditions, and (2) the NRC's failure to acknowledge that no ISL operation has ever been able to restore groundwater to pre-mining conditions.

1. *Groundwater Restoration Impact Analyses are Based on Averaging Poor Quality Groundwater with Good Quality Groundwater.*

Instead of considering restoration based on actual pre-mining groundwater quality, the NRC ties restoration, in both the GEIS and the SEIS, to the **average** of poor groundwater in the immediate ore zone with good groundwater quality outside the ore zone but within a mine area.

The description of the affected environment in the SEIS reflects this bias toward inflating pre-mining contamination levels. Tables 3-4 and 3-5 purport to show the baseline or background groundwater quality in the aquifers underlying the Nichols Ranch Unit and the Hank Unit respectively. SEIS at 3-20 – 3-22. These tables leave the impression that the aquifers within the proposed mine boundaries exceed EPA and Wyoming water quality standards for several constituents. Elsewhere in the SEIS, however, the NRC discloses that some groundwater samples in the ore bearing aquifer met EPA water quality standards. *Id.* at 3-19. Because of the NRC's practice of averaging good groundwater quality with poor groundwater quality, these results are incomplete and misleading.

Moreover, average groundwater concentrations are virtually meaningless, especially if the sample locations, date of sampling and individual constituent concentrations are not disclosed or unknown. Therefore, instead of disclosing the average constituent concentrations in a particular aquifer, the SEIS should disclose all the groundwater sampling data, including the sample locations, date of sampling, and constituent concentrations. The written lab reports should also be included as part of the record. If those data are not available, the SEIS should disclose that fact.

Further, the practice of averaging good and poor groundwater quality misleads the public. It skews the impact analysis toward minimizing the groundwater impacts of ISL mining in general and the Nichols Ranch project in particular. In contrast, if groundwater quality within an ore zone and outside an ore zone (which has better pre-mining water quality) is analyzed separately and not averaged, the adverse impacts on groundwater outside the ore zone would be substantially larger. By averaging the pre-mining water quality outside and inside the ore zone,

the NRC is hiding the real groundwater impacts an ISL operation may have. Neither NEPA nor its implementing regulations contemplate such a result.

2. The NRC Fails to Disclose that No ISL Operation has Ever Restored Groundwater to Pre-mining Conditions.

Even though the NRC uses a mathematical artifice that inflates the pre-mining contaminant levels within a project's boundaries to leave the impression that baseline groundwater conditions are poor and that restoration is possible, the NRC fails to disclose that no ISL operation in the United States has **ever** restored groundwater to pre-mining conditions. The GEIS's brief discussion of ISL restoration history implies that while restoration may be difficult at times, there have been some successful restoration projects. GEIS at 2-51. The GEIS's discussion of the impacts of groundwater restoration is similarly conclusory and misleading. The GEIS's analysis of groundwater impacts from restoration is largely limited to an ISL operation's effects on groundwater quantity, not quality. *Id.* at 4.3-17 – 4.3-19. The GEIS's discussion of potential groundwater quality impacts in the "Wyoming East Milling Region" is limited to a single paragraph and does not mention the invariable failure of ISL operations to restore groundwater to pre-mining conditions. *Id.* at 4.3-18.

The SEIS's analysis of groundwater impacts from restoration is also insufficient. The SEIS relies entirely on the GEIS's framework for analyzing groundwater quality impacts. The NRC's site-specific analysis of groundwater impacts at the Nichols Ranch project is therefore limited to consumptive impacts, i.e., water quantity. In the two pages of analysis that the SEIS devotes to groundwater impacts from restoration, there is no discussion of the fact that, historically, groundwater restoration at ISL projects has been unsuccessful. Indeed, the SEIS merely incorporates the analysis presented in the GEIS and concludes that groundwater restoration impacts will be small. SEIS at 4-31.

Neither the GEIS nor the SEIS reflect the actual groundwater restoration history of ISL mines. The United States Geological Survey ("USGS") recently published a survey of restoration efforts in Texas[5]. Hall, Susan, *Groundwater Restoration at Uranium In-Situ Recovery Mines, South Texas Coastal Plain.* U.S. Geological Survey Open-Rile Report 2009-1143 (2009). That report is attached hereto as Attachment G. That report concludes that based on restoration efforts in Texas - the state with the longest history of ISL mining and with the most comprehensive database of restoration information - no ISL uranium mine has ever restored groundwater to pre-mining conditions, even if one considers the inflated pre-mining average contaminant levels as a legitimate representation of baseline. Attachment G at 21. These findings are consistent with the NRC's own data which also demonstrate that ISL operation restoration efforts that are considered "successful" actually do not restore groundwater to pre-mining conditions. *Consideration of Geochemical Issues in Groundwater Restoration in Uranium In-Situ Leach Mining Facilities*, NUREG CR-6870 (Jan. 2007) at p.19, Table 3; p. 20, Table 4; p. 21, Table 5; p. 22, Table 6. Moreover, the same NRC report determines that after "restoration" has been deemed complete, contaminant levels may actually rise and migrate due to geochemical conditions. *Id.* at 17, 22, 23. Because the data show that, to date, restoring groundwater to pre-mining conditions has been unachievable, the NRC's conclusion that impacts to groundwater from groundwater restoration will be small is arbitrary and unreasonable. The NRC should fully disclose the ISL industry's groundwater restoration history and reconsider the impacts to groundwater, both regionally and locally, based on that history.

[5] While Texas is an agreement state and the NRC therefore does not have direct regulatory authority over ISL mines in that state, the regulatory framework in Texas is substantially the same and the NRC's, the NRC has oversight authority over the Texas regulatory system, and the technology used to "restore" groundwater is identical to the technology that will be used for the Nichols Ranch project.

3. *The NRC's Groundwater Restoration Impacts Analysis Contradicts NRC Regulations.*

Finally, the NRC appears to evaluate groundwater restoration impacts assuming that if baseline groundwater quality is not achieved, "class of use" quality would be achievable. GEIS at 2-48. However, this analysis ignores that the NRC regulations governing ISL groundwater restoration make no mention of "class of use" as a restoration standard, and mandates that groundwater must be restored to background or the maximum contamination levels listed in Criterion 5D. 10 C.F.R., Part 40, Appendix A, Criterion 5B; *see also, In the Matter of Hydro Resources, Inc.*, CLI-99-22, 50 NRC 3, 8-9 (1999). Indeed, even the NRC Staff recognizes that "class of use" is an inappropriate restoration goal. In 2009, the Staff issued a Regulatory Issue Summary ("RIS") where it concluded that Criterion 5B did not provide for restoration to "class of use" standards. RIS 2009-05 at 3-4 (April 29, 2009). Specifically the Staff wrote:

> [T]he requirements in Criterion 5B of Appendix A apply to restoration of groundwater at uranium ISR facilities. The staff recognizes that NUREG-1569, "Standard Review Plan for In Situ Leach Uranium Extraction License Applications," provides guidance that is not consistent with the requirements in Criterion 5B of Appendix A discussed above. In particular, the NUREG-1569 discussion of groundwater restoration to "pre-operational class of use" as being a secondary standard is not accurate, **and is not an appropriate standard to use in evaluating license applications**. Criterion 5B contains the appropriate standards that will be applied to groundwater restoration at ISR facilities.

Id. at 3 (emphasis added).

Moreover, the "class of use" restoration standard in the GEIS and SEIS illustrates a fundamental problem with the NRC's regulatory framework. As noted in SRIC's comments on the draft GEIS, which are incorporated by reference herein, one of the significant problems with issuing the GEIS is that it would become a proxy for ISL regulations. SRIC et. al., Comments on Draft GEIS, §III at 3-6 (Nov. 7, 2008). The NRC does not have regulations specifically relevant to ISL operations; instead, the NRC has adapted some of the conventional milling regulations to

apply to ISL operations and have filled in the remaining gaps with license conditions, the ISL Standard Review Plan, and the GEIS. The way the NRC has used the GEIS and the SEIS in the Nichols Ranch project context simply confirms this *ad hoc* approach to ISL regulation. Thus, because "class of use" is a restoration standard that is not legally cognizable, it should not be the basis for an analysis of groundwater impacts.

V. The NRC Failed to Conduct Public Scoping for the SEIS

In preparing the GEIS, the NRC held a series of public scoping meetings to determine what issues should be addressed in the GEIS. *See*, 72 Fed. Reg. 40,344 (July 24, 2007). Although many public comments urged the NRC to consider the impacts of previous uranium mining and milling, it deemed impacts from past uranium mining and milling to be outside the GEIS's scope. GEIS at 1-15.

In the SEIS, the NRC adopted the GEIS's scope, i.e., it would not disclose or analyze the impacts from past uranium mining and milling. SEIS at 1-2. However, unlike the GEIS, the NRC did not conduct **any** public meetings regarding the SEIS's scope. Instead, the NRC met with government agencies and groups it considered "interested" in the SEIS and apparently determined the scope based on those meetings. As a result, for example, the SEIS fails to consider an entire class of impacts, i.e., the cumulative impacts of past uranium mining and milling combined with the current project, based on a exclusionary process. The failure to conduct scoping on the SEIS also prevents the public from raising issues including and in addition to the cumulative impacts of past uranium mining and milling that should have been considered in the SEIS. Moreover, the NRC's failure to conduct public scoping meetings in and of itself constitutes a violation of NEPA. The NRC must therefore scrap the current SEIS, conduct public scoping meetings, and issue another draft SEIS for public comment.

VI. Cumulative Impacts Analysis is Inadequate

Finally, both the GEIS's and the SEIS's cumulative impacts analyses are grossly inadequate. The Council on Environmental Quality ("CEQ") regulations provide:

> Cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

40 C.F.R. § 1508.7. The NRC fails to consider cumulative impacts in either the GEIS or the SEIS in a number of respects.

Although the GEIS is the most appropriate document in which to consider the regional cumulative impacts of ISL mining, it fails entirely to analyze the cumulative impacts from proposed ISL projects. GEIS at 5-1 ("Due to the complex and site-specific nature of a cumulative impact assessment, this chapter provides useful information for understanding the potential for cumulative impacts when licensing future ISL facilities in the milling regions, but does not make any conclusions regarding cumulative impacts that could be applied to specific sites"). Instead, the NRC defers cumulative impact consideration for site specific SEISs. *Id.* Thus, by its own terms, the GEIS does not take the "hard look" at cumulative environmental impacts required by NEPA. However, as with the statement of purpose and need, the purported site-specific cumulative impacts analysis relies heavily on information in the GEIS as its basis. The NRC thereby evades any meaningful cumulative impacts analysis altogether.

Because it relies substantially on information provided in the GEIS, the cumulative impacts analysis in the SEIS is equally inadequate. Rather than meaningfully evaluating cumulative impacts, the SEIS instead simply lists other Federal projects (incorporated from the GEIS) for which environmental impact statements have been or are proposed to be generated and

included a seemingly boilerplate and conclusory statement that those projects "may" cause cumulative impacts. *See, e.g*, SEIS § 5.5.2, p. 5-10 ("cumulative impacts from ISR activities and [coalbed methane] activities may occur, bur are unlikely" because ISL operators and coalbed methane operators will monitor their respective activities); § 5.5.1, p. 5-10 ("coal extraction, natural gas, uranium extraction, and cattle ranching may cumulatively impact surface water resources"); § 5.7, p. 5-13 ("surface coal mines have the potential to cumulatively impact air quality in the region").

The NRC should have presented a detailed analysis that would have informed agency decision-making and public input, instead of presenting a conclusory analysis of the cumulative impacts. For example, the NRC should have disclosed what contaminants are released by coal bed methane operations, such as pit wastes, hydrological fracturing fluids, TENORM, and produced water and into which aquifers and surface waters those contaminants are likely released. The NRC should have then analyzed how the significantly elevated levels of uranium, radium and other pollutants that will be released from the ore zone and circulated through the aquifer at the Nichols Ranch project incrementally impact ground and surface water quality locally and regionally when combined with contaminants from coalbed methane production.

A similar analysis of incremental impacts on important resources such as ground and surface water, air and ecosystems should have been conducted for all the other industrial projects in the area, including oil and gas development. As demonstrated in SRIC's Attachments H, I, and J, significant chemical contaminants are associated with oil and gas production, from the chemicals in drilling and hydrological fracturing fluids to the waste that goes into pits. As noted in Attachments H, I, and J, these chemicals have known adverse health effects, including carcinogenic and mutagenic properties, endocrine disrupting effects, and acute toxic effects.

Instead of analyzing the cumulative impacts of the Nichols Ranch project combined with nearby oil and gas operations, the SEIS merely lists the number of oil and gas wells regionally. SEIS § 5.1.1.3 at 5-5.

The SEIS also fails entirely to evaluate either the cumulative impacts from non-Federal projects combined with the Nichols Ranch project. The SEIS acknowledges that most rangeland in the area is privately owned and used for livestock grazing. *Id.* at 5-7. However, the SEIS fails to evaluate how the impacts from livestock grazing, such as erosion and surface water contamination might interact with the surface water impacts from the Nichols Ranch project.

Finally, neither the SEIS nor the GEIS adequately evaluates the cumulative impacts of the Nichols Ranch project combined with contamination from past uranium mining and milling. Indeed, in the GEIS, the NRC determined that contamination from past uranium mining and milling was beyond the GEIS's scope. GEIS § 1.5.4 at 1-14. The GEIS further provides, "[e]valuating the potential impacts from past mining activities on new ISL proposals is a site-specific analysis that, if applicable to a proposed site, would be evaluated by applicants during the site characterization and by the NRC staff when a site-specific licensing review is conducted." *Id.*, § 5.2.1 at 5-3. Although the GEIS does not provide any analysis of cumulative impacts from past uranium mining or milling, it does outline a protocol for determining whether these cumulative impacts should be considered in a site-specific evaluation. *Id.* at 5-2 and Appendix F. The NRC's decision-making framework outlined in the GEIS, effectively pre-determined to what extent cumulative impacts will be analyzed in a site-specific context. *Id.* at 5-27. In the GEIS, the NRC states that it anticipates that most site-specific cumulative impact analyses will only require a Level 1 or Level 2 evaluation. *Id.* In other words, while evading any meaningful discussion of cumulative impacts in GEIS, the NRC nevertheless manages to

restrict any future site-specific evaluations to the most superficial of analyses. This was clearly not Congress's intent in enacting NEPA.

This proactive restriction of cumulative impacts analysis is illustrated by the treatment of cumulative impacts from past uranium mining and milling in the Nichols Ranch SEIS. The NRC's SEIS merely provides a list of the past, current and reasonably foreseeable uranium mining and milling projects in the region. SEIS, Table 5-1 at 5-2 – 5-3. This Table is obviously adapted from Table 5.2-1 in the GEIS. GEIS at 5-4 – 5-7. As in the GEIS, the SEIS provides no quantification or analysis of the cumulative impacts of the past, present and reasonably foreseeable projects combined with the Nichols Ranch project.

Without disclosing and analyzing how those impacts, combined with the impacts from the Nichols Ranch Project, affect the environment and public health, the NRC cannot make a fully informed decision and the public cannot have meaningful input into the decision-making process. The NRC must consider the full range of cumulative impacts in accordance with NEPA. Therefore, the NRC should re-issue the GEIS - which is the more appropriate document for analyzing cumulative impacts - for public comment on its cumulative impacts analysis.

VII. Conclusion

The above comments demonstrate that both the GEIS and the Nichols Ranch SEIS are inadequate pursuant to NEPA, the NRC's regulations implementing NEPA, and the Council on Environmental Quality regulations implementing NEPA. The NRC must withdraw the Nichols Ranch SEIS, begin a meaningful scoping process for the Nichols Ranch environmental impact statement, and re-issue the SEIS for public comment. Further, the NRC should not rely on the GEIS for any aspect of site-specific analysis.

Thank you for the opportunity to comment on the Nichols Ranch SEIS and please do not

hesitate to contact me if you have any questions or concerns.

Eric Jantz

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Alternatives Evaluated in the Generic Environmental Impact Statement for In Situ Leach Uranium Milling Facilities

In anticipation of receiving numerous license applications for new in situ leach (ISL) uranium recovery facilities (commonly known as in situ recovery facilities) in 2008 through 2010, the staff of the U.S. Nuclear Regulatory Commission (NRC) has prepared a Generic Environmental Impact Statement (GEIS). In doing so, the NRC staff analyzed common environmental issues associated with the construction, operation, and decommissioning of ISL facilities, as well as the ground water restoration at such facilities, if they are located in particular regions of the western United States. (See Locations of Uranium Recovery Facilities for detail.) As a result, the GEIS will promote more efficient reviews of applications that may be received in the coming years. Toward that end, the NRC staff will use the GEIS as starting point for its site-specific environmental review of license applications for new ISL facilities, as well as applications to renew or amend existing ISL licenses.

In preparing the GEIS, the NRC staff evaluated the following alternatives:

- **No action.** Deny the applicant's request for a new ISL facility license, or the licensee's request to renew or amend a current license. This alternative serves as a baseline for comparing the potential environmental impacts.
- **Proposed action.** Grant the request to obtain, renew, or amend a source material license for an ISL facility. Implementation of the proposed action would require the issuance or amendment of an NRC license under the provisions of Title 10, Part 40, of the *Code of Federal Regulations* (10 CFR Part 40), "Domestic Licensing of Source Material."

February 18, 2010

MEMORANDUM FOR HEADS OF FEDERAL DEPARTMENTS AND AGENCIES

FROM: NANCY H. SUTLEY, Chair, Council on Environmental Quality

SUBJECT: DRAFT NEPA GUIDANCE ON CONSIDERATION OF THE EFFECTS OF CLIMATE CHANGE AND GREENHOUSE GAS EMISSIONS

I. INTRODUCTION

The Council on Environmental Quality (CEQ) provides this draft guidance memorandum for public consideration and comment on the ways in which Federal agencies can improve their consideration of the effects of greenhouse gas (GHG) emissions[1] and climate change in their evaluation of proposals for Federal actions under the National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4321 et seq. This draft guidance is intended to help explain how agencies of the Federal government should analyze the environmental effects of GHG emissions and climate change when they describe the environmental effects of a proposed agency action in accordance with Section 102 of NEPA and the CEQ Regulations for Implementing the Procedural Provisions of NEPA, 40 C.F.R. parts 1500-1508. This draft guidance affirms the requirements of the statute and regulations and their applicability to GHGs and climate change impacts. CEQ proposes to advise Federal agencies that they should consider opportunities to reduce GHG emissions caused by proposed Federal actions and adapt their actions to climate change impacts throughout the NEPA process and to address these issues in their agency NEPA procedures.

The environmental analysis and documents produced in the NEPA process should provide the decision maker with relevant and timely information about the environmental effects of his or her decision and reasonable alternatives to mitigate those impacts. In this context, climate change issues arise in relation to the consideration of:

(1) The GHG emissions effects of a proposed action and alternative actions; and
(2) The relationship of climate change effects to a proposed action or alternatives, including the relationship to proposal design, environmental impacts, mitigation and adaptation measures.

NEPA demands informed, realistic governmental decision making. CEQ proposes to advise Federal agencies to consider, in scoping their NEPA analyses, whether analysis of the direct and indirect GHG emissions from their proposed actions may provide meaningful information to decision makers and the public. Specifically, if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of CO_2-equivalent GHG emissions on an annual basis, agencies should consider this an indicator that a quantitative and qualitative assessment may be meaningful to decision makers and the public. For long-term actions that have annual direct emissions of less than 25,000

[1] For purposes of this guidance, CEQ defines "GHGs" in accordance with Section 19(i) of Executive Order 13514 (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride).

metric tons of CO_2-equivalent, CEQ encourages Federal agencies to consider whether the action's long-term emissions should receive similar analysis. CEQ does not propose this as an indicator of a threshold of significant effects, but rather as an indicator of a minimum level of GHG emissions that may warrant some description in the appropriate NEPA analysis for agency actions involving direct emissions of GHGs.

CEQ does not propose to make this guidance applicable to Federal land and resource management actions, but seeks public comment on the appropriate means of assessing the GHG emissions and sequestration that are affected by Federal land and resource management decisions.

Because climate change is a global problem that results from global GHG emissions, there are more sources and actions emitting GHGs (in terms of both absolute numbers and types) than are typically encountered when evaluating the emissions of other pollutants. From a quantitative perspective, there are no dominating sources and fewer sources that would even be close to dominating total GHG emissions. The global climate change problem is much more the result of numerous and varied sources, each of which might seem to make a relatively small addition to global atmospheric GHG concentrations. CEQ proposes to recommend that environmental documents reflect this global context and be realistic in focusing on ensuring that useful information is provided to decision makers for those actions that the agency finds are a significant source of GHGs.

With regards to the effects of climate change on the design of a proposed action and alternatives, Federal agencies must ensure the scientific and professional integrity of their assessment of the ways in which climate change is affecting or could affect environmental effects of the proposed action. 40 CFR 1502.24. Under this proposed guidance, agencies should use the scoping process to set reasonable spatial and temporal boundaries for this assessment and focus on aspects of climate change that may lead to changes in the impacts, sustainability, vulnerability and design of the proposed action and alternative courses of action. At the same time, agencies should recognize the scientific limits of their ability to accurately predict climate change effects, especially of a short-term nature, and not devote effort to analyzing wholly speculative effects. Agencies can use the NEPA process to reduce vulnerability to climate change impacts, adapt to changes in our environment, and mitigate the impacts of Federal agency actions that are exacerbated by climate change.

Finally, CEQ seeks public comment on several issues not directly addressed by this draft guidance, including the assessment of climate change effects of land management activities, and means by which agencies can tailor the amount of the documentation prepared for NEPA analysis so that it is proportional to the importance of climate change to the decision-making process.

II. CONSIDERATION OF THE EFFECTS OF A PROPOSED AGENCY ACTION ON GHG EMISSIONS: WHEN TO EVALUATE GHG EMISSIONS

By statutes, Executive Orders, and agency policies, the Federal government is committed to the goals of energy conservation, reducing energy use, eliminating or reducing GHG emissions, and promoting the deployment of renewable energy technologies that are cleaner and more efficient. Where a proposal for Federal agency action implicates these goals, information on GHG emissions (qualitative or quantitative) that is useful and relevant to the decision should be used when deciding among alternatives.

Many projects and programs proposed by the Federal government have the potential to emit GHGs. Accordingly, where a proposed Federal action that is analyzed in an EA or EIS would be anticipated to emit GHGs to the atmosphere in quantities that the agency finds may be meaningful, it is appropriate for the agency to quantify and disclose its estimate of the expected annual direct and indirect GHG emissions in the environmental documentation for the proposed action. Where the proposed

activity is subject to GHG emissions accounting requirements, such as Clean Air Act reporting requirements that apply to stationary sources that directly emit 25,000 metric tons or more of CO_2-equivalent GHG on an annual basis,[2] the agency should include this information in the NEPA documentation for consideration by decision makers and the public. CEQ does not propose this reference point for use as a measure of indirect effects, the analysis of which must be must be bounded by limits of feasibility in evaluating upstream and downstream effects of Federal agency actions. In the agency's analysis of direct effects, it would be appropriate to: (1) quantify cumulative emissions over the life of the project; (2) discuss measures to reduce GHG emissions, including consideration of reasonable alternatives; and (3) qualitatively discuss the link between such GHG emissions and climate change. However, it is not currently useful for the NEPA analysis to attempt to link specific climatological changes, or the environmental impacts thereof, to the particular project or emissions, as such direct linkage is difficult to isolate and to understand. The estimated level of GHG emissions can serve as a reasonable proxy for assessing potential climate change impacts, and provide decision makers and the public with useful information for a reasoned choice among alternatives.

The reference point of 25,000 metric tons of direct CO_2-equivalent GHG emissions may provide agencies with a useful indicator – rather than an absolute standard of insignificant effects -- for agencies' action-specific evaluation of GHG emissions and disclosure of that analysis in their NEPA documents. CEQ does not propose this reference point as an indicator of a level of GHG emissions that may significantly affect the quality of the human environment, as that term is used by NEPA, but notes that it serves as a minimum standard for reporting emissions under the Clean Air Act. Evaluation of significance under NEPA is done by the action agency based on the categorization of actions in agency NEPA procedures and action-specific analysis of the context and intensity of the environmental impacts. 40 CFR 1501.4, 1508.27. Examples of proposals for Federal agency action that may warrant a discussion of the GHG impacts of various alternatives, as well as possible measures to mitigate climate change impacts, include: approval of a large solid waste landfill; approval of energy facilities such as a coal-fired power plant; or authorization of a methane venting coal mine. Other Federal policies, programs, or plans that cover multiple actions subject to NEPA – such as actions tiered from programmatic NEPA documents – may more appropriately address GHG emissions at the level of individual projects. In many cases, the GHG emissions of the proposed action may be so small as to be a negligible consideration. Agency NEPA procedures may identify actions for which GHG emissions and other environmental effects are neither individually or cumulatively significant. 40 CFR 1507.3.

Many agency NEPA analyses to date have found that GHG emissions from an individual agency action have small potential effects. Emissions from many proposed Federal actions would not typically be expected to produce an environmental effect that would trigger or otherwise require a detailed discussion in an EIS. Significant national policy decisions for which the action's GHG impacts are expected to be substantial have, on the other hand, required analysis of their GHG effects.

HOW TO EVALUATE GHG EMISSIONS

To describe the impact of an agency action on GHG emissions, once an agency has determined that this is appropriate, CEQ proposes that agencies should consider quantifying those emissions using the

[2] 25,000 metric tons may provide a useful, presumptive, threshold for discussion and disclosure of GHG emissions because it has been used and proposed in rule-makings under the Clean Air Act (e.g., EPA's Mandatory Reporting of Greenhouse Gases Final Rule, 74 FR 56260, October 30, 2009). This threshold is used in Clean Air Act rule-makings because it provides comprehensive coverage of emissions with a reasonable number of reporters, thereby creating an important data set useful in quantitative analyses of GHG policies, programs and regulations. See 74 FR 56272. This rationale is pertinent to the presentation of NEPA analysis as well.

following technical documents, to the extent that this information is useful and appropriate for the proposed action under NEPA:

- For quantification of emissions from large direct emitters: 40 CFR Parts 86, 87, 89, et al. Mandatory Reporting of Greenhouse Gases; Final Rule, U.S. Environmental Protection Agency (74 Fed. Reg. 56259-56308). Note that "applicability tools" are available (http://www.epa.gov/climatechange/emissions/GHG-calculator/) for determining whether projects or actions exceed the 25,000 metric ton of CO2-equivalent greenhouse gas emissions.
- For quantification of Scope 1 emissions at Federal facilities: Greenhouse gas emissions accounting and reporting guidance that will be issued under Executive Order 13514 Sections 5(a) and 9(b) (http://www.ofee.gov)
- For quantification of emissions and removals from terrestrial carbon sequestration and various other project types: Technical Guidelines, Voluntary Reporting of Greenhouse Gases, (1605(b) Program, U.S. Department of Energy (http://www.eia.doe.gov/oiaf/1605/))

Land management techniques, including changes in land use or land management strategies, lack any established Federal protocol for assessing their effect on atmospheric carbon release and sequestration at a landscape scale. Therefore, at this time, CEQ seeks public comment on this issue but has not identified any protocol that is useful and appropriate for NEPA analysis of a proposed land and resource management actions.

CEQ notes that agencies may also find useful information in the following sources:

- Renewable Energy Requirements Guidance for EPACT 2005 and EO 13423 (http://www.ofee.gov/eo/epact05_fedrenewenergyguid_final_on_web.pdf)
- EPA Climate Leaders GHG Inventory Protocols (http://www.epa.gov/climateleaders/resources/inventory-guidance.html)

For proposed actions that are not adequately addressed in the GHG emission reporting protocols listed above, agencies should use NEPA's provisions for inter-agency consultation with available expertise to identify and follow the best available procedures for evaluating comparable activities. Agencies should consider the emissions source categories, measurement methodologies and reporting criteria outlined in these documents, as applicable to the proposed action, and follow the relevant procedures for determining and reporting emissions. The NEPA process does not require submitting a formal report or participation in the reporting programs. Rather, under this proposed guidance, only the methodologies relevant to the emissions of the proposed project need to be considered and disclosed to decision makers and the public.

WHAT DEPARTMENTS AND AGENCIES SHOULD CONSIDER AS PART OF THEIR GHG EVALUATION

Federal agencies should structure their NEPA processes "to help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment." 40 CFR 1502.1. Inherent in NEPA and the CEQ implementing regulations is a "'rule of reason,' which ensures that agencies determine whether and to what extent to prepare an EIS based on the usefulness of any new potential information to the decisionmaking process." *DOT v. Public Citizen,* 541 U.S. 752, 767 (2004). Where a proposed action is evaluated in either an EA or an EIS, the agency may look to reporting thresholds in the technical documents cited above as a point of reference for

determining the extent of direct GHG emissions analysis that is appropriate to the proposed agency decision. As proposed in draft guidance above, for Federal actions that require an EA or EIS the direct and indirect GHG emissions from the action should be considered in scoping and, to the extent that scoping indicates that GHG emissions warrant consideration by the decision maker, quantified and disclosed in the environmental document. 40 CFR 1508.25. In assessing direct emissions, an agency should look at the consequences of actions over which it has control or authority. *Public Citizen,* 541 U.S. at 768. When a proposed federal action meets an applicable threshold for quantification and reporting, as discussed above, CEQ proposes that the agency should also consider mitigation measures and reasonable alternatives to reduce action-related GHG emissions. Analysis of emissions sources should take account of all phases and elements of the proposed action over its expected life, subject to reasonable limits based on feasibility and practicality.

For proposed actions evaluated in an EIS, Federal agencies typically describe their consideration of the energy requirements of a proposed action and the conservation potential of its alternatives. 40 CFR 1502.16(e). Within this description of energy requirements and conservation opportunities, agencies should evaluate GHG emissions associated with energy use and mitigation opportunities and use this as a point of comparison between reasonable alternatives. For proposals normally evaluated in an EA, agencies may consider the GHG emissions as a factor in discussing alternative uses of available resources. 40 CFR 1508.9(b). CEQ proposes that this analysis should also consider applicable Federal, State or local goals for energy conservation and alternatives for reducing energy demand or GHG emissions associated with energy production.

Where an agency concludes that a discussion of cumulative effects of GHG emissions related to a proposed action is warranted to inform decision-making, CEQ recommends that the agency do so in a manner that meaningfully informs decision makers and the public regarding the potentially significant effects in the context of the proposal for agency action. This would most appropriately focus on an assessment of annual and cumulative emissions of the proposed action and the difference in emissions associated with alternative actions. Agencies may incorporate USGCRP studies and reports by reference in any discussion of GHG emissions and their effects. 40 CFR 1502.21.

Agencies apply the rule of reason to ensure that their discussion pertains to the issues that deserve study and deemphasizes issues that are less useful to the decision regarding the proposal, its alternatives, and mitigation options. 40 CFR 1500.4(f), (g), 1501.7, 1508.25. In addressing GHG emissions, consistent with this proposed guidance, CEQ expects agencies to ensure that such description is commensurate with the importance of the GHG emissions of the proposed action, avoiding useless bulk and boilerplate documentation, so that the NEPA document may concentrate attention on important issues. 40 CFR 1502.5, 1502.24.

An agency may decide that it would be useful to describe GHG emissions in aggregate, as part of a programmatic analysis of agency activities that can be incorporated by reference into subsequent NEPA analyses for individual agency actions. In addition, Federal programs that affect emissions or sinks and proposals regarding long range energy, transportation, and resource management programs lend themselves to a programmatic approach. For example, if GHG emissions or climate change and related effects in general are included in a broad (i.e., programmatic) EIS for a program, subsequent NEPA analyses for actions implementing that program at the project level should, if useful in the NEPA analysis for that decision, tier from the programmatic statement and summarize the relevant issues discussed in the programmatic statement. 40 CFR 1502.20, 1508.28. Such aggregated discussion may be useful under the consideration of agency compliance with requirements for Federal agencies to implement sustainable practices for energy efficiency, GHG emissions avoidance or reduction, petroleum products use reduction, and renewable energy, including bioenergy as well as other required sustainable practices. See, Executive Order 13514 – Federal Leadership in Environmental, Energy, and Economic Performance (74

Fed. Reg. 52117-52127); Executive Order 13423 - Strengthening Federal Environmental, Energy, and Transportation Management (http://nepa.gov/nepa/regs/E.O._13423.pdf). In particular, NEPA analyses for individual actions may incorporate by reference agency Strategic Sustainability Plans and account for GHG effects in accordance with Federal GHG reporting and accounting procedures to the extent that they are applicable to actions that carry out agency obligations under subsections 2(a), (b), (c) and (f) of Executive Order 13514. Such reference to the programmatic accounting of Federal agency GHG emissions under EO 13514 should note where appropriate that the scope of this accounting (for Scope 1, 2 and 3 emissions) may be much broader than the emissions that would be reasonable for assessment within the scope of an individual agency action under NEPA.

To the extent that a federal agency evaluates proposed mitigation of GHG emissions, the quality of that mitigation – including its permanence, verifiability, enforceability, and additionality[3] – should also be carefully evaluated. Among the alternatives that may be considered for their ability to reduce or mitigate GHG emissions are enhanced energy efficiency, lower GHG-emitting technology, renewable energy, planning for carbon capture and sequestration, and capturing or beneficially using fugitive methane emissions. In some cases, such activities are part of the purpose and need for the proposed action and the analysis will provide an assessment, in a comparative manner, of the alternatives and their relative ability to advance those objectives.

III. CONSIDERATION OF CURRENT OR PROJECTED EFFECTS OF CLIMATE CHANGE ON PROPOSALS FOR AGENCY ACTION

CEQ proposes that agencies should determine which climate change impacts warrant consideration in their EAs and EISs because of their impact on the analysis of the environmental effects of a proposed agency action. Through scoping of an environmental document, agencies determine whether climate change considerations warrant emphasis or de-emphasis. 40 CFR 1500.4(g), 1501.7; See Scoping Guidance (CEQ 1981) (http://www.nepa.gov/nepa/regs/scope/scoping.htm) When scoping the impact of climate change on the proposal for agency action, the sensitivity, location, and timeframe of a proposed action will determine the degree to which consideration of these predictions or projections is warranted. As with analysis of any other present or future environment or resource condition, the observed and projected effects of climate change that warrant consideration are most appropriately described as part of the current and future state of the proposed action's "affected environment." 40 CFR 1502.15. Based on that description of climate change effects that warrant consideration, the agency may assess the extent that the effects of the proposal for agency action or its alternatives will add to, modify, or mitigate those effects. Such effects may include, but are not limited to, effects on the environment, on public health and safety, and on vulnerable populations who are more likely to be adversely affected by climate change. The final analysis documents an agency assessment of the effects of the actions considered, including alternatives, on the affected environment.

Climate change can affect the environment of a proposed action in a variety of ways. For instance, climate change can affect the integrity of a development or structure by exposing it to a greater risk of floods, storm surges, or higher temperatures. Climate change can increase the vulnerability of a resource, ecosystem, or human community, causing a proposed action to result in consequences that are more damaging than prior experience with environmental impacts analysis might indicate. For example, an industrial process may draw cumulatively significant amounts of water from a stream that is dwindling because of decreased snow pack in the mountains or add significant heat to a water body that is exposed

[3] Regulatory additionality requirements are designed to ensure that GHG reduction credit is limited to an entity with emission reductions that are above regulatory requirements. See http://www.eia.doe.gov/oiaf/1605/FAQ_GenInfoA.htm#Additionality;

to increasing atmospheric temperatures. Finally, climate change can magnify the damaging strength of certain effects of a proposed action.

Using NEPA's "rule of reason" governing the level of detail in any environmental effects analysis, agencies should ensure that they keep in proportion the extent to which they document their assessment of the effects of climate change. The focus of this analysis should be on the aspects of the environment that are affected by the proposed action and the significance of climate change for those aspects of the affected environment. Agencies should consider the specific effects of the proposed action (including the proposed action's effect on the vulnerability of affected ecosystems), the nexus of those effects with projected climate change effects on the same aspects of our environment, and the implications for the environment to adapt to the projected effects of climate change. The level of detail in the analysis and NEPA documentation of these effects will vary among affected resource values. For example, if a proposed project requires the use of significant quantities of water, changes in water availability associated with climate change may need to be discussed in greater detail than other consequences of climate change. In some cases, discussion of climate change effects in an EA or EIS may warrant a separate section, while in others such discussion may be integrated into the broader discussion of the affected environment.

When assessing the effects of climate change on a proposed action, an agency typically start with an identification of the reasonably foreseeable future condition of the affected environment for the "no action" alternative based on available climate change measurements, statistics, observations, and other evidence. See *Considering Cumulative Effects* (CEQ 1997) at www.nepa.gov. The reasonably foreseeable affected environment should serve as the basis for evaluating and comparing the incremental effects of alternatives. 40 CFR 1502.15. Agencies should be clear about the basis for projecting the changes from the existing environment to the reasonably foreseeable affected environment, including what would happen under this scenario and the probability or likelihood of this future condition. The obligation of an agency to discuss particular effects turns on "a reasonably close causal relationship between the environmental effect and the alleged cause." *Public Citizen*, 541 U.S. at 767. Where climate change effects are likely to be important but there is significant uncertainty about such effects, it may also be useful to consider the effects of any proposed action or its alternatives against a baseline of reasonably foreseeable future conditions that is drawn as distinctly as the science of climate change effects will support.

Climate change effects should be considered in the analysis of projects that are designed for long-term utility and located in areas that are considered vulnerable to specific effects of climate change (such as increasing sea level or ecological change) within the project's timeframe. For example, a proposal for long-term development of transportation infrastructure on a coastal barrier island will likely need to consider whether environmental effects or design parameters may be changed by the projected increase in the rate of sea level rise. See *Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study,* (http://www.globalchange.gov/publications/reports/scientific-assessments/saps/sap4-7), and *Abrupt Climate Change* ((http://www.globalchange.gov/publications/reports/scientific-assessments/saps/sap3-4 (discussing the likelihood of an abrupt change in sea level). Given the length of time involved in present sea level projections, such considerations typically would not be relevant to an action with only short-term considerations.

The process of adaptive planning requires constant learning to reduce uncertainties and improve adaptation outcomes. The CEQ NEPA regulations recognize the value of monitoring to assure that decisions are carried out as provided in a Record of Decision. 40 CFR 1505.3. In cases where adaptation to the effects of climate change is important, the significant aspects of these changes should be identified in the agency's final decision and adoption of a monitoring program should be considered. Monitoring

strategies should be modified as more information becomes available and best practices and other experiences are shared.

For sources of the best scientific information available on the reasonably foreseeable climate change impacts, Federal agencies may summarize and incorporate by reference the Synthesis and Assessment Products of the U.S. Global Change Research Program (USGCRP, http://www.globalchange.gov/publications/reports/scientific-assessments/saps), and other major peer-reviewed assessments from USGCRP . Particularly relevant is the report on climate change impacts on water resources, ecosystems, agriculture and forestry, health, coastlines and arctic regions in the United States. *Global Climate Change Impacts in the United States* (http://www.globalchange.gov/publications/reports/scientific-assessments/us-impacts). Research on climate change impacts is an emerging and rapidly evolving area of science. In accordance with NEPA's rule of reason and standards for obtaining information regarding reasonably foreseeable significant adverse effects on the human environment, action agencies need not undertake exorbitant research or analysis of projected climate change impacts in the project area or on the project itself, but may instead summarize and incorporate by reference the relevant scientific literature. See, e.g., 40 CFR 1502.21, 1502.22. Where agencies consider climate change modeling to be applicable to their NEPA analysis, agencies should consider the uncertainties associated with long-term projections from global and regional climate change models. There are limitations and variability in the capacity of climate models to reliably project potential changes at the regional, local, or project level, so agencies should disclose these limitations in explaining the extent to which they rely on particular studies or projections. 40 CFR 1502.21, 1502.22. The outputs of coarse-resolution global climate models, commonly used to project climate change scenarios at a continental or regional scale, require downscaling and bias removal (i.e., the adjustment of future projections for known systematic model errors) before they can be used in regional or local impact studies. See *Climate Models: An Assessment of Strengths and Limitations.* (http://www.globalchange.gov/publications/reports/scientific-assessments/saps/sap3-1).

Agencies should also consider the particular impacts of climate change on vulnerable communities where this may affect the design of the action or the selection among alternatives. Tribal and Alaska Native communities that maintain their close relationship with the cycles of nature have observed the changes that are already underway, including the melting of permafrost in Alaska, disappearance of important species of trees, shifting migration patterns of elk and fish, and the drying of lakes and rivers. These effects affect the survival for both their livelihood and their culture. Further, sovereign tribal governments with legal rights to reservations and trust resources are affected by ecological changes on the landscape in ways that many Americans are not.

IV. BACKGROUND

1. NEPA and Cumulative Effects in General

NEPA was enacted to, *inter alia,* "promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man." NEPA Section 2, 42 U.S.C. § 4321. NEPA is best known for its action-forcing requirement that "all agencies of the federal government shall . . . include in every recommendation or report on . . . major federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on –

(i) the environmental impact of the proposed action,
(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,
(iii) alternatives to the proposed action,
(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented."

NEPA Section 102(2) (C), 42 U.S.C. § 4332(2) (C). This information must be provided for review by agencies with jurisdiction or special expertise regarding the environmental effects described. The agency's "detailed statement," known as an EIS, must be provided to the public, in accordance with NEPA Section 102(2)(C) and the Freedom of Information Act, and be incorporated into the agency decision-making process.

The EIS requirement thus has two purposes. First, it is meant to promote transparency and to ensure public accountability of agency decisions with significant environmental effects. In this sense, it promotes political checks and balances broader public interests against the motivations for agency action. Second, it is meant to ensure that agencies take account of those effects before decisions are made and as part of the agency's own decision-making process. In this sense, it attempts to ensure that agencies consider environmental consequences as they decide how to proceed and take steps, when appropriate, to eliminate or mitigate adverse effects. The agency's "responsibility is not simply to sit back, like an umpire, and resolve adversary contentions . . . Rather, it must itself take the initiative of considering environmental values at every distinctive and comprehensive stage of the process beyond the staff's evaluation and recommendation." *Calvert Cliffs Coordinating Comm., Inc. v. US Atomic Energy Comm'n*, 449 F.2d 1109, 1119 (D.C. Cir. 1971).

Alternatives analysis is an essential element of the NEPA process, both under section 102(2) (C) and in the EA of "conflicts concerning alternative uses of available resources" under Section 102(2) (E). The requirement of consideration of alternatives is meant to ensure that the agency consider approaches whose adverse environmental effects will be insignificant or at least less significant than those of the proposal. "This requirement, like the 'detailed statement' requirement, seeks to ensure that each agency decision maker has before him and takes into proper account all possible approaches to a particular project (including total abandonment of the project) which would alter the environmental impact and the cost-benefit balance. Only in that fashion is it likely that the most intelligent, optimally beneficial decision will ultimately be made." *Calvert Cliffs*, 449 F.2d at 1114.

NEPA analysis and documentation should be designed to both inform Federal agency decisions and provide for collaborative, coordinated decisions by making "advice and information useful in restoring, maintaining, and enhancing the quality of the environment" available to States, Tribes, counties, cities, institutions and individuals. Section 102(2) (G), 42 U.S.C. § 4332(2) (G). NEPA also requires Federal agencies to support international cooperation by recognizing "the global character of environmental problems and, where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment." Section 102(2) (F), 42 U.S.C. § 4332(2) (F).

Federal actions may cause effects on the human environment that are not significant environment effects, in isolation, but that are significant in the aggregate or that will lead to significant effects. Since 1970, CEQ has construed the term "major Federal actions significantly affecting the quality of the human environment" as requiring the consideration of the "overall, cumulative impact of the action proposed (and of further actions contemplated)." 35 Fed. Reg. 7390, 7391 (1970). "Cumulative impact" is defined in CEQ's NEPA regulations as the "impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions . . ." 40 C.F.R. § 1508.7. Cf. *Kleppe v. Sierra Club*, 427 U.S. 390, 413-414 (1976). CEQ interprets this regulation as referring only to the cumulative impact of the direct and indirect effects of the proposed action or its alternatives when added to the aggregate effects of past, present, and reasonably foreseeable future

actions. See, CEQ Guidance on the Consideration of Past Actions in Cumulative Effects Analysis (June 24, 2005) at 2, 3 (www.nepa.gov/nepa/regs/Guidance_on_CE.pdf).

As explained in prior CEQ guidance, and described in its handbook *Considering Cumulative Effects,* the analysis of cumulative effects begins with consideration of the direct and indirect effects on the environment that are expected or likely to result from a proposal for agency action or its reasonable alternatives. See *Considering Cumulative Effects* (CEQ 1997) at www.nepa.gov. Agencies then should consider the affected environment by looking for effects of past, present, and reasonably foreseeable future actions that are, in the judgment of the agency, relevant because their effects would increase or change in combination with the direct and indirect effects of the proposal for agency action or its alternatives. The relevant cumulative effects typically result from human activities with effects that accumulate within the temporal and geographic boundaries of the effects of the proposed action.

The purpose of cumulative effects analysis is to document agency consideration of the context and intensity of the effects of a proposal for agency action, particularly whether the action is related to other actions with individually insignificant but cumulatively significant impacts. 40 CFR 1508.27(b)(7). After such documentation, the dual purposes of NEPA will be satisfied. The public can scrutinize the relevant effects, and the agency, having been made alert to them, can decide how to proceed. The Supreme Court has emphasized that agencies may properly limit the scope of their cumulative effects analysis based on practical considerations. *Kleppe*, 427 U.S at 414 ("Even if environmental interrelationships could be shown conclusively to extend across basins and drainage areas, practical considerations of feasibility might well necessitate restricting the scope of comprehensive statements"). See also 40 CFR 1502.22 (regarding acquisition and disclosure of information that is "relevant to reasonably foreseeable significant adverse impacts" and "essential to a reasoned choice among alternatives").

2. Climate Change in General.

The science of climate change is rapidly developing, and is only briefly summarized in this guidance to illustrate the sources of scientific information that are presently available for consideration. CEQ's first Annual Report in 1970 discussed climate change, concluding that "man may be changing his weather." Environmental Quality: The First Annual Report at 93. At that time, human activities had increased the mean level of atmospheric carbon dioxide to 325 parts per million (ppm). Since 1970, the concentration of atmospheric carbon dioxide has increased at a rate of about 1.6 ppm per year (1979-2008) to the present level of approximately 385 ppm (2008 globally averaged value). *See* U.S. Department of Commerce, National Oceanic and Atmospheric Administration Earth Systems Research Laboratory (http://www.esrl.noaa.gov/gmd/ccgg/trends/). The atmospheric concentrations of other, more potent GHGs have also increased to levels that far exceed their levels in 1750, at the beginning of the industrial era. As of 2004, human activities annually produced more than 49 billion tons of GHG measured in carbon dioxide equivalency according to the Intergovernmental Panel on Climate Change (IPCC). IPCC Fourth Assessment Report: Synthesis Report at 38 (http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf). Nearly every aspect of energy choices and use affect the development of fossil fuel and other energy resources, either adding to or reducing the cumulative total of GHG emissions.

It is now well established that rising global GHG emissions are significantly affecting the Earth's climate. These conclusions are built upon a scientific record that has been created with substantial contributions from the United States' Global Change Research Program (formerly the Climate Change Science Program), which facilitates the creation and application of knowledge of the Earth's global environment through research, observations, decision support, and communication. (http://www.globalchange.gov/)

Based primarily on the scientific assessments of the USGCRP and NRC, EPA has issued a finding that the changes in our climate caused by GHG emissions endanger public health and welfare. (Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, December 15, 2009, 74 Fed. Reg. 66496). Ambient concentrations of GHGs do not cause direct adverse health effects (such as respiratory or toxic effects), but public health risks and impacts as a result of elevated atmospheric concentrations of GHGs occur via climate change. 74 Fed. Reg. at 66497-98. For example, EPA has estimated that climate change can exacerbate tropospheric ozone levels in some parts of the U.S. Broadly, EPA states that the effects of climate change observed to date and projected to occur in the future include, but are not limited to, more frequent and intense heat waves, more severe wildfires, degraded air quality, more heavy downpours and flooding, increased drought, greater sea-level rise, more intense storms, harm to water resources, harm to agriculture, and harm to wildlife and ecosystems. The Administrator has determined that these impacts are effects on public health and welfare within the meaning of the Clean Air Act. However, the Administrator does not currently believe that it is possible to quantify with great specificity (i.e. geographic), the various health effects from climate change but, because the risks from unusually hot days and nights and from heat waves are very serious, has proposed to find that on balance that these risks support a finding that public health is endangered even if it is also possible that modest temperature increases will have some beneficial health effects. The EPA findings cite IPCC reports that climate change impacts on human health in U.S. cities will be compounded by population growth and an aging population and GCRP reports that climate change has the potential to accentuate the disparities already evident in the American health care systems as many of the expected health effects are likely to fall disproportionately on the poor, the elderly, the disabled, and the uninsured.

V. CONCLUSION

With the purpose of informing decision-making, CEQ proposes that the NEPA process should incorporate consideration of both the impact of an agency action on the environment through the mechanism of GHG emissions and the impact of changing climate on that agency action. This is not intended as a "new" component of NEPA analysis, but rather as a potentially important factor to be considered within the existing NEPA framework. Where an agency determines that an assessment of climate issues is appropriate, the agency should identity alternative actions that are both adapted to anticipated climate change impacts and mitigate the GHG emissions that cause climate change. As noted above, NEPA analysis of climate change issues necessarily will evolve to reflect the scientific information available and the legal and policy context of decisions that the NEPA process is intended to inform. Therefore, once this guidance is issued in final form, CEQ intends to revise it as warranted to reflect developments in the law, policy, and science regarding climate change.

VI. SPECIFIC QUESTIONS FOR PUBLIC REVIEW

In addition to comments on this draft guidance document, CEQ also requests comment on land and resource management issues, including:

1. How should NEPA documents regarding long-range energy and resource management programs assess GHG emissions and climate change impacts?
2. What should be included in specific NEPA guidance for projects applicable to the federal land management agencies?
3. What should be included in specific NEPA guidance for land management planning applicable to the federal land management agencies?
4. Should CEQ recommend any particular protocols for assessing land management practices and their effect on carbon release and sequestration?

5. How should uncertainties associated with climate change projections and species and ecosystem responses be addressed in protocols for assessing land management practices?
6. How should NEPA analyses be tailored to address the beneficial effects on GHG emissions of Federal land and resource management actions?
7. Should CEQ provide guidance to agencies on determining whether GHG emissions are "significant" for NEPA purposes. At what level should GHG emissions be considered to have significant cumulative effects. In this context, commenters may wish to consider the Supreme Court decision in *Massachusetts v. EPA*, 549 U.S. 497, 524 (2007).

After consideration of public comment, CEQ intends to expeditiously issue this guidance in final form. In the meantime, CEQ does not intend this guidance to become effective until its issuance in final form.

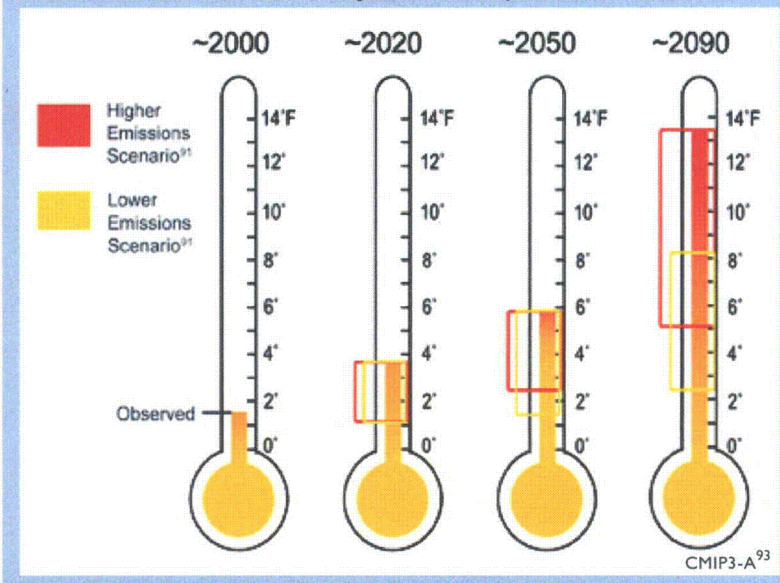
# # #

Great Plains

The Great Plains is characterized by strong seasonal climate variations. Over thousands of years, records preserved in tree rings, sediments, and sand deposits provide evidence of recurring periods of extended drought (such as the Dust Bowl of the 1930s) alternating with wetter conditions.[97,419]

Today, semi-arid conditions in the western Great Plains gradually transition to a moister climate in the eastern parts of the region. To the north, winter days in North Dakota average 25°F, while it is not unusual to have a West Texas winter day over 75°F. In West Texas, there are between 70 and 100 days per year over 90°F, whereas North Dakota has only 10 to 20 such days on average.

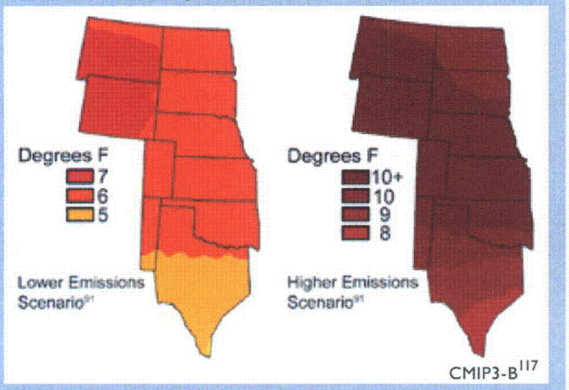
Observed and Projected Temperature Rise



The average temperature in the Great Plains already has increased roughly 1.5°F relative to a 1960s and 1970s baseline. By the end of the century, temperatures are projected to continue to increase by 2.5°F to more than 13°F compared with the 1960 to 1979 baseline, depending on future emissions of heat-trapping gases. The brackets on the thermometers represent the likely range of model projections, though lower or higher outcomes are possible.

Significant trends in regional climate are apparent over the last few decades. Average temperatures have increased throughout the region, with the largest changes occurring in winter months and over the northern states. Relatively cold days are becoming less frequent and relatively hot days more frequent.[420] Precipitation has also increased over most of the area.[149,421]

Summer Temperature Change by 2080-2099



Temperatures in the Great Plains are projected to increase significantly by the end of this century, with the northern part of the region experiencing the greatest projected increase in temperature.

Temperatures are projected to continue to increase over this century, with larger changes expected under scenarios of higher heat-trapping emissions as compared to lower heat-trapping emissions. Summer changes are projected to be larger than those in winter in the southern and central Great Plains.[108] Precipitation is also projected to change, particularly in winter and spring. Conditions are anticipated to become wetter in the north and drier in the south.

Projected changes in long-term climate and more frequent extreme events such as heat waves, droughts, and heavy rainfall will affect many aspects of life in the Great Plains. These include the region's already threatened water resources, essential agricultural and ranching activities, unique natural and protected areas, and the health and prosperity of its inhabitants.

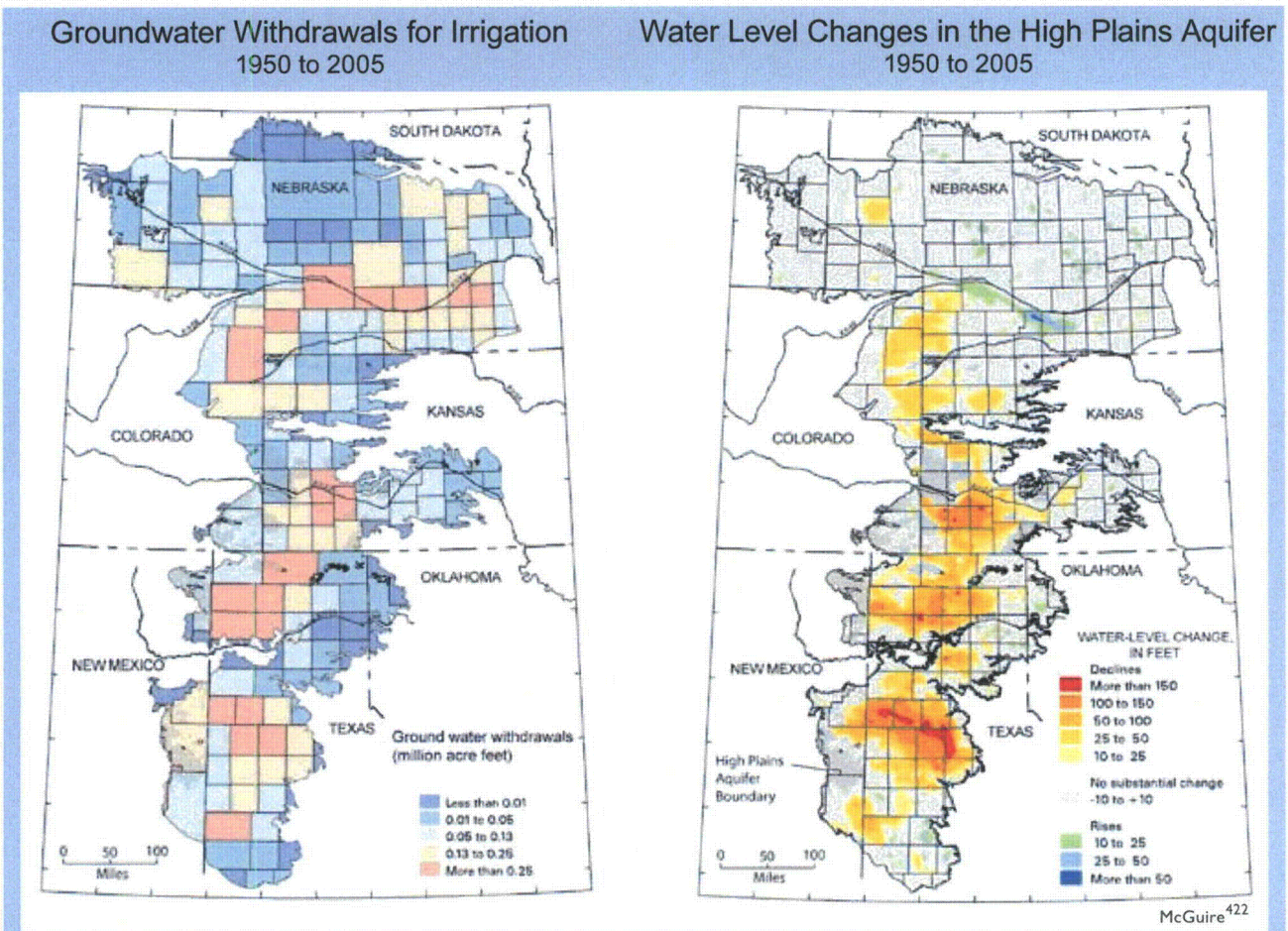
Projected increases in temperature, evaporation, and drought frequency add to concerns about the region's declining water resources.

Water is the most important factor affecting activities on the Great Plains. Most of the water used in the Great Plains comes from the High Plains aquifer (sometimes referred to by the name of its largest formation, the Ogallala aquifer), which stretches from South Dakota to Texas. The aquifer holds both current recharge from precipitation and so-called "ancient" water, water trapped by silt and soil washed down from the Rocky Mountains during the last ice age.

As population increased in the Great Plains and irrigation became widespread, annual water withdrawals began to outpace natural recharge.[422]

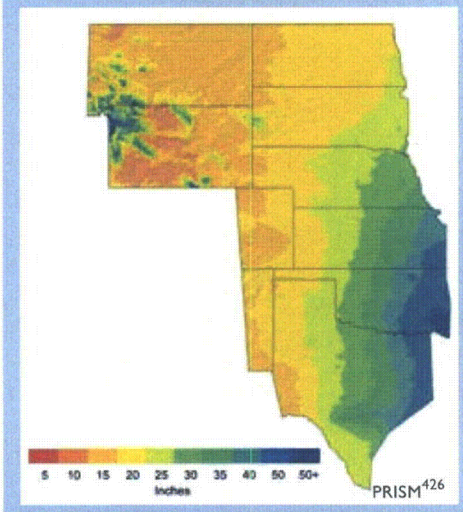
Today, an average of 19 billion gallons of groundwater are pumped from the aquifer each day. This water irrigates 13 million acres of land and provides drinking water to over 80 percent of the region's population.[423] Since 1950, aquifer water levels have dropped an average of 13 feet, equivalent to a 9 percent decrease in aquifer storage. In heavily irrigated parts of Texas, Oklahoma, and Kansas, reductions are much larger, from 100 feet to over 250 feet.

Projections of increasing temperatures, faster evaporation rates, and more sustained droughts brought on by climate change will only add more stress to overtaxed water sources.[149,253,424,425] Current water use on the Great Plains is unsustainable, as the High Plains aquifer continues to be tapped faster than the rate of recharge.



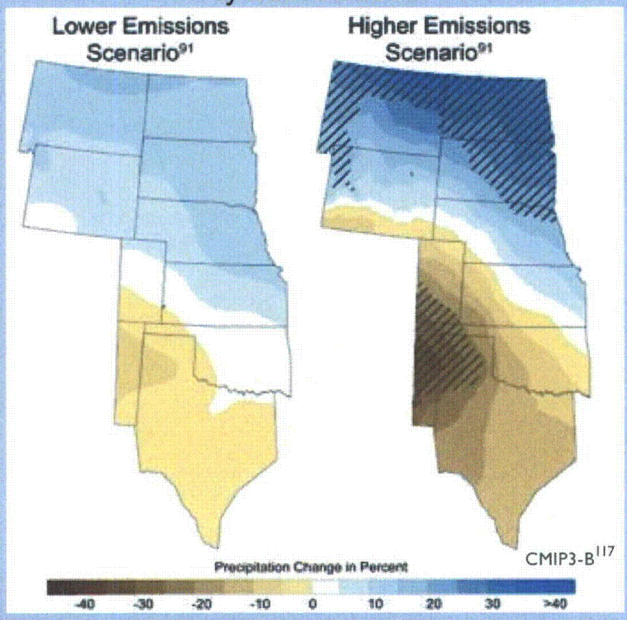
Irrigation is one of the main factors stressing water resources in the Great Plains. In parts of the region, more than 81 trillion gallons of water (pink areas on the left hand map) were withdrawn for irrigation in Texas, Oklahoma, and Kansas from 1950 to 2005. During the same time period, water levels in parts of the High Plains aquifer in those states decreased by more than 150 feet (red areas on the right hand map).

Average Annual Observed Precipitation
1971-2000



The Great Plains currently experiences a sharp precipitation gradient from east to west, from more than 50 inches of precipitation per year in eastern Oklahoma and Texas to less than 10 inches in some of the western parts of the region.

Projected Spring Precipitation Change by 2080s-2090s



Northern areas of the Great Plains are projected to experience a wetter climate by the end of this century, while southern areas are projected to experience a drier climate. The change in precipitation is compared with a 1960-1979 baseline. Confidence in the projected changes is highest in the hatched areas.

The Dust Bowl: Combined Effects of Land Use and Climate

Over the past century, large-scale conversion of grasslands to crops and ranchland has altered the natural environment of the Great Plains.[149] Irrigated fields have increased evaporation rates, reducing summer temperatures, and increasing local precipitation.[427,428]

The Dust Bowl of the 1930s epitomizes what can happen as a result of interactions between climate and human activity. In the 1920s, increasing demand for food encouraged poor agricultural practices. Small-scale producers ploughed under native grasses to plant wheat, removing the protective cover the land required to retain its moisture.

Dust Bowl of 1935 in Stratford, Texas

Variations in ocean temperature contributed to a slight increase in air temperatures, just enough to disrupt the winds that typically draw moisture from the south into the Great Plains. As the intensively tilled soils dried up, topsoil from an estimated 100 million acres of the Great Plains blew across the continent.

The Dust Bowl dramatically demonstrated the potentially devastating effects of poor land-use practices combined with climate variability and change.[429] Today, climate change is interacting with a different set of poor land-use practices. Water is being pumped from the Ogallala aquifer faster than it can recharge. In many areas, playa lakes are poorly managed (see page 127). Existing stresses on water resources in the Great Plains due to unsustainable water usage are likely to be exacerbated by future changes in temperature and precipitation, this time largely due to human-induced climate change.

Agriculture, ranching, and natural lands, already under pressure due to an increasingly limited water supply, are very likely to also be stressed by rising temperatures.

Agricultural, range, and croplands cover more than 70 percent of the Great Plains, producing wheat, hay, corn, barley, cattle, and cotton. Agriculture is fundamentally sensitive to climate. Heat and water stress from droughts and heat waves can decrease yields and wither crops.[430,431] The influence of long-term trends in temperature and precipitation can be just as great.[431]

As temperatures increase over this century, optimal zones for growing particular crops will shift. Pests that were historically unable to survive in the Great Plains' cooler areas are expected to spread northward. Milder winters and earlier springs also will encourage greater numbers and earlier emergence of insects.[149] Rising carbon dioxide levels in the atmosphere can increase crop growth, but also make some types of weeds grow even faster (see *Agriculture* sector).[432]

Projected increases in precipitation are unlikely to be sufficient to offset decreasing soil moisture and water availability in the Great Plains due to rising temperatures and aquifer depletion. In some areas, there is not expected to be enough water for agriculture to sustain even current usage.

With limited water supply comes increased vulnerability of agriculture to climate change. Further stresses on water supply for agriculture and ranching are likely as the region's cities continue to grow, increasing competition between urban and rural users.[433] The largest impacts are expected in heavily irrigated areas in the southern Great Plains, already plagued by unsustainable water use and greater frequency of extreme heat.[149]

Successful adaptation will require diversification of crops and livestock, as well as transitions from irrigated to rain-fed agriculture.[434-436] Producers who can adapt to changing climate conditions are likely to see their businesses survive; some might even thrive. Others, without resources or ability to adapt effectively, will lose out.

Climate change is likely to affect native plant and animal species by altering key habitats such as the wetland ecosystems known as prairie potholes or playa lakes.

Ten percent of the Great Plains is protected lands, home to unique ecosystems and wildlife. The region is a haven for hunters and anglers, with its ample supplies of wild game such as moose, elk, and deer; birds such as goose, quail, and duck; and fish such as walleye and bass.

Climate-driven changes are likely to combine with other human-induced stresses to further increase the vulnerability of natural ecosystems to pests, invasive species, and loss of native species. Changes in temperature and precipitation affect the composition and diversity of native animals and plants through altering their breeding patterns, water and food supply, and habitat availability.[149] In a changing climate, populations of some pests such as red fire ants and rodents, better adapted to a warmer climate, are projected to increase.[437,438] Grassland and plains birds, already besieged by habitat fragmentation, could experience significant shifts and reductions in their ranges.[439]

Urban sprawl, agriculture, and ranching practices already threaten the Great Plains' distinctive wetlands. Many of these are home to endangered and iconic species. In particular, prairie wetland ecosystems provide crucial habitat for migratory waterfowl and shorebirds.

Mallard ducks are one of the many species that inhabit the playa lakes, also known as prairie potholes.

Ongoing shifts in the region's population from rural areas to urban centers will interact with a changing climate, resulting in a variety of consequences.

Inhabitants of the Great Plains include a rising number of urban dwellers, a long tradition of rural communities, and extensive Native American

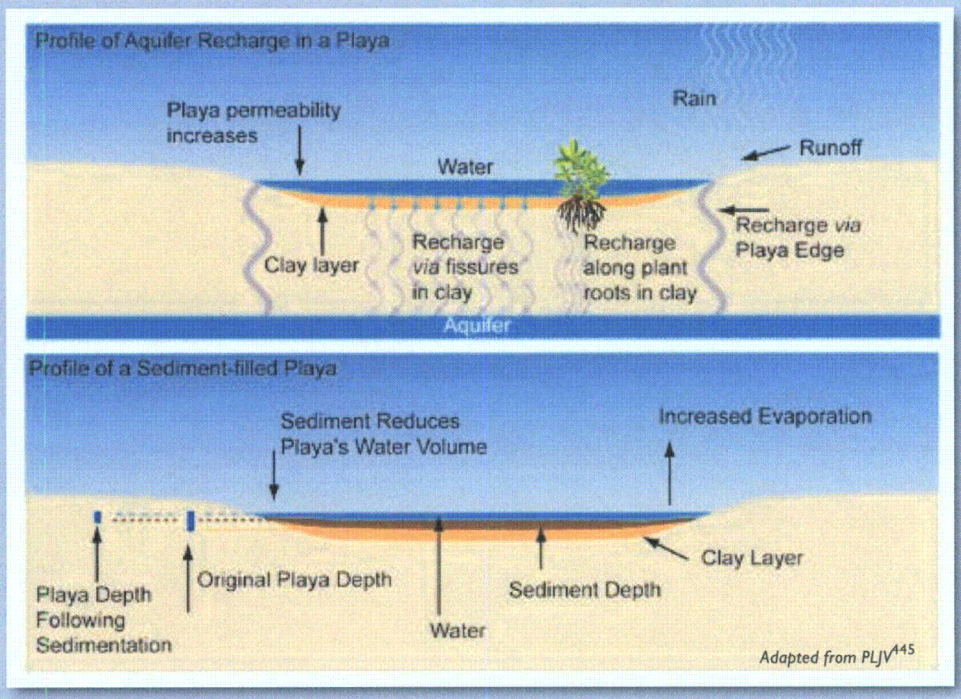
Playa Lakes and Prairie Potholes

Playa lakes in west Texas fill up after a heavy spring rain.

Shallow ephemeral lakes dot the Great Plains, anomalies of water in the arid landscape. In the north they are known as prairie potholes; in the south, playa lakes. These lakes create unique microclimates that support diverse wildlife and plant communities. A playa can lie with little or no water for long periods, or have several wet/dry cycles each year. When it rains, what appeared to be only a few clumps of short, dry grasses just a few days earlier suddenly teems with frogs, toads, clam shrimp, and aquatic plants.

The playas provide a perfect home for migrating birds to feed, mate, and raise their young. Millions of shorebirds and waterfowl, including Canada geese, mallard ducks, and Sandhill cranes, depend on the playas for their breeding grounds. From the prairie potholes of North Dakota to the playa lakes of West Texas, the abundance and diversity of native bird species directly depends on these lakes.[440,441]

Despite their small size, playa lakes and prairie potholes also play a critical role in supplying water to the Great Plains. The contribution of the playa lakes to this sensitively balanced ecosystem needs to be monitored and maintained in order to avoid unforeseen impacts on our natural resources. Before cultivation, water from these lakes was the primary source of recharge to the High Plains aquifer.[442] But many playas are disappearing and others are threatened by growing urban populations, extensive agriculture, and other filling and tilling practices.[443] In recent years, agricultural demands have drawn down the playas to irrigate crops. Agricultural waste and fertilizer residues drain into playas, decreasing the quality of the water, or clogging them so the water cannot trickle down to refill the aquifer. Climate change is expected to add to these stresses, with increasing temperatures and changing rainfall patterns altering rates of evaporation, recharge, and runoff to the playa lake systems.[444]



populations. Although farming and ranching remain primary uses of the land – taking up much of the region's geographical area – growing cities provide housing and jobs for more than two-thirds of the population. For everyone on the Great Plains, though, a changing climate and a limited water supply are likely to challenge their ability to thrive, leading to conflicting interests in the allocation of increasingly scarce water resources.[313,433]

Native American communities

The Great Plains region is home to 65 Native American tribes. Native populations on rural tribal lands have limited capacities to respond to climate change.[313] Many reservations already face severe problems with water quantity and quality – problems likely to be exacerbated by climate change and other human-induced stresses.

Rural communities

As young adults move out of small, rural communities, the towns are increasingly populated by a vulnerable demographic of very old and very young people, placing them more at risk for health issues than urban communities. Combined effects of changing demographics and climate are likely to make it more difficult to supply adequate and efficient public health services and educational opportunities to rural areas. Climate-driven shifts in optimal crop types and increased risk of drought, pests, and extreme events will add more economic stress and tension to traditional communities.[430,433]

Urban populations

Although the Great Plains is not yet known for large cities, many mid-sized towns throughout the region are growing rapidly. One in four of the most rapidly growing cities in the nation is located in the Great Plains[446] (see *Society* sector). Most of these growing centers can be found in the southern parts of the region, where water resources are already seriously constrained. Urban populations, particularly the young, elderly, and economically disadvantaged, may also be disproportionately affected by heat.[447]

New opportunities

There is growing recognition that the enormous wind power potential of the Great Plains could provide new avenues for future employment and land use. Texas already produces the most wind power of any state. Wind energy production is also prominent in Oklahoma. North and South Dakota have rich wind potential.[191]

As climate change creates new environmental conditions, effective adaptation strategies become increasingly essential to ecological and socioeconomic survival. A great deal of the Great Plains' adaptation potential might be realized through agriculture. For example, plant species that mature earlier and are more resistant to disease and pests are more likely to thrive under warmer conditions.

Other emerging adaptation strategies include dynamic cropping systems and increased crop diversity. In particular, mixed cropping-livestock systems maximize available resources while minimizing the need for external inputs such as irrigation that draws down precious water supplies.[436] In many parts of the region, diverse cropping systems and improved water use efficiency will be key to sustaining crop and rangeland systems.[448] Reduced water supplies might cause some farmers to alter the intensive cropping systems currently in use.[193,219]

Adaptation: Agricultural Practices to Reduce Water Loss and Soil Erosion

Conservation of water is critical to efficient crop production in areas where water can be scarce. Following the Dust Bowl in the 1930s, Great Plains farmers implemented a number of improved farming practices to increase the effectiveness of rainfall capture and retention in the soil and protect the soil against water and wind erosion. Examples include rotating crops, retaining crop residues, increasing vegetative cover, and altering plowing techniques.

With observed and projected increases in summer temperatures and in the frequency and intensity of heavy downpours, it will become even more important to protect against increasing loss of water and soil. Across the upper Great Plains, where strong storms are projected to occur more frequently, producers are being encouraged to increase the amount of crop residue left on the soil or to plant cover crops in the fall to protect the soil in the spring before crops are planted.

Across the southern Great Plains, some farmers are returning to dryland farming rather than relying on irrigation for their crops. Preserving crop residue helps the soil absorb more moisture from rain and eases the burden on already-stressed groundwater. These efforts have been promoted by the U.S. Department of Agriculture through research and extension efforts such as Kansas State University's Center for Sustainable Agriculture and Alternative Crops.

From: HARDGROVE Tom (AREVA RESOURCES INC) [tom.hardgrove@areva.com]
Sent: Thursday, December 17, 2009 2:56 PM
To: Linton, Ron
Subject: Lists of Spills and Excursions for COMIN
Attachments: LISTS OF COMIN SPILLS & EXCURSIONS.pdf

Importance: High

Ron,

Per your request, see attachment. I have added the excursion at CR just reported today.

Tom

Received: from mail1.nrc.gov (148.184.176.41) by OWMS01.nrc.gov
(148.184.100.43) with Microsoft SMTP Server id 8.1.393.1; Thu, 17 Dec 2009
14:56:36 -0500
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with ESMTP; 17 Dec 2009 14:56:35 -0500
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<Ron.Linton@nrc.gov>; Thu, 17 Dec 2009 19:56:34 +0000 (UTC)
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Subject: Lists of Spills and Excursions for COMIN
Date: Thu, 17 Dec 2009 14:56:28 -0500
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X-MS-TNEF-Correlator:
Thread-Topic: Lists of Spills and Excursions for COMIN
Thread-Index: Acp/UwVln3BV3QtlSnOmWEkuFc83ig==
From: "HARDGROVE Tom (AREVA RESOURCES INC)" <tom.hardgrove@areva.com>
To: "Linton, Ron" <Ron.Linton@nrc.gov>
X-OriginalArrivalTime: 17 Dec 2009 19:56:34.0687 (UTC) FILETIME=[093398F0:01CA7F53]
Return-Path: tom.hardgrove@areva.com

TABLE 1.1 IRIGARAY PROJECT SPILLS

See the Irigaray Project - General Location and Spill Map for spill locations sites.

					Spill Solution (mg/l)		Soil Sample (pCi/g)	
Number	Date	Location	Spill Solution	Volume (Gallons)	Uranium as U308	Ra226	Uranium as U	Ra226
1	12/11/1980	South side of plant	Yellowcake slurry	< 55				
2	09/03/87	Unit 5 trunkline	Wellfield	4,200	1.0			
3	12/17/87	Unit 7 trunkline	Wellfield	12,000	0.3			
4	04/20/88	Main wellfield building	Wellfield	1,500	1.2			
5	05/28/88	Unit 6 - 9 trunkline	Wellfield	2,000	1.1			
6	08/06/88	Unit 6 - 9 trunkline	Wellfield	11,000	1.2			
7	08/21/88	Unit 6 - 9 trunkline	Wellfield	6,000	1.5			
8	01/03/89	GI-142	Wellfield	1,000				
9	01/03/89	GI-142	Wellfield	1,000				
1	01/04/89	HI-82	Wellfield	5,000				
11	01/06/89	HI-13	Wellfield	2,500				
12	01/09/89	LP-66	Wellfield	1,500				
13	01/18/89	JI-127	Wellfield	1,000				
14	01/21/89	BI-40	Wellfield	4,000				
15	01/22/89	GI-30	Wellfield	1,600				
16	01/22/89	FI-42	Wellfield	1,000				
17	01/22/89	GI-132	Wellfield	1,500				
18	01/30/89	GP-36	Wellfield	1,000				
19	01/31/89	GI-84	Wellfield	2,500				
20	01/31/89	DI-20	Wellfield	3,000				
21	02/07/89	DI-101	Wellfield	3,000				
22	02/07/89	LP-28	Wellfield	3,000				
23	02/09/89	GP-58	Wellfield	1,500				
24	02/10/89	HI-97	Wellfield	1,000				
25	02/10/89	DI-31	Wellfield	1,400				
26	02/12/89	AI-37	Wellfield	1,000				
27	02/15/89	HI-34	Wellfield	1,000				
28	02/23/89	GP-57	Wellfield	1,500				
29	02/23/89	GI-27	Wellfield	1,120				
30	02/23/89	HI-102	Wellfield	1,000				
31	02/26/89	HP-85	Wellfield	2,000				
32	03/04/89	LP-25	Wellfield	1,000				
33	03/10/89	EI-90	Wellfield	2,000				
34	03/12/89	GI-18	Wellfield	1,000				
35	03/13/89	HP-67	Wellfield	2,000				
36	03/13/89	FI-108	Wellfield	3,000				
37	03/13/89	GI-149	Wellfield	2,500				
38	03/20/89	GP-5	Wellfield	1,250				
39	04/09/89	AI-30	Wellfield	1,000				
40	04/17/89	Unit 8/9 building	Wellfield	2,000				
41	04/25/89	Unit 1 injection	Wellfield	1,000				
42	04/30/89	GI-137	Wellfield	1,000				
43	05/05/89	FI-117	Wellfield	1,500				
44	11/10/89	GP-61	Wellfield	1,000	<15			
45	12/11/89	Unit 7 trunkline	Wellfield	2,000	1.2			
46	12/23/89	Unit 6 Prod. well	Wellfield	1,500	20.0			
47	05/02/90	JP-50	Wellfield	1,000	14.5			
48	05/09/90	Unit 1-5 recovery line	Wellfield	2,000	16.3			
49	05/24/90	S. side of plant	Wellfield	7,000	21.6		1.56	1.8
50	05/31/90	FI-119	Wellfield	1,000	26.2			
51	06/01/90	DP-36	Wellfield	1,000	11.9			
52	06/01/90	CI-17	Wellfield	1,000	15.3			
53	06/04/90	EP-13	Wellfield	1,000	6.8			
54	06/05/90	EP-13	Wellfield	500	6.8			
55	06/29/90	EP-13	Wellfield	350	9.4			
56	05/02/90	JP-50	Wellfield	1,000	14.5			
57	07/08/90	EP-13	Wellfield	200	9.3			
58	08/26/90	Restoration building	Wellfield	3,000	15.9			
59	09/15/90	Restoration building	Process	500	5.3			2.6
60	09/16/90	AP-10	Wellfield	200	18.1			
61	10/04/90	South side of plant	Process	330	4780			
62	11/02/90	Pond D	Pond	1,000	7.1			0.3
63	11/03/91	HP-9	Wellfield	700	17.4			

64	11/10/91	EI-33	Wellfield	2,500	1.3			
65	11/20/91	Between pond A + B	Pond	2,000	15.0			
66	11/22/91	AP-8	Wellfield	3,000	<0.1			
67	12/22/91	DI-86	Wellfield	2,000			26.50	43.9
68	12/30/91	Unit 5	Wellfield	2,000	12.9			23.0
69	01/15/92	FI-97	Wellfield	5,000	8.3			1.6
70	01/18/92	EP-13	Wellfield	1,000			38.70	2.2
71	01/19/92	DI-11	Wellfield	2,000			138.00	12.0
72	01/22/92	BP-8	Wellfield	2,000	3.7		28.10	1.2
73	01/25/92	FP-13	Wellfield	6,000			147.00	20.1
74	01/25/92	HP-68	Wellfield	2,500			44.80	9.1
75	02/19/92	EI-90	Wellfield	2,000	0.2		2.60	1.3
76	02/19/92	T42-1	Wellfield	2,500	12.6		7.10	3.5
77	02/22/92	L20-1	Wellfield	1,000	16.1		0.06	17.2
78	06/30/92	DP-14	Wellfield	5,000	3.8		43.50	5.1
79	07/25/92	Restoration building	Pond	5,000	11.6		13.30	1.5
80	08/03/92	CI-20	Wellfield	3,000	3.5			
81	08/05/92	FP-35	Wellfield	5,000	7.4		0.60	0.9
82	09/03/92	DI-64	Wellfield	2,000	8.0			
83	12/23/92	FI-110	Wellfield	1,700	2.6			
84	04/12/93	Trunkline behind plant annex	Pond	5,000	10.0		4.80	1.0
85	05/03/93	Between plant and wellfield	Pond	6,000	16.7		6.00	1.3
86	05/16/93	GI-84	Wellfield	500	5.5			
87	06/15/93	GI-129	Wellfield	750	7.3			
88	07/03/93	FI-119B	Wellfield	1,000	8.2		9.80	7.8
89	07/07/93	LP-49	Wellfield	12,200	18.0		10.30	6.1
90	07/13/93	JI-44	Wellfield	3,000	18.0		94.50	254.0
91	08/05/93	UNIT 7	Wellfield	1,080	16.2			
92	09/12/93	HP-49	Wellfield	8,000	26.3		5.40	1.2
93	11/17/93	LI-68	Wellfield	1,500	0.5			
94	11/22/93	KP-53	Wellfield	1,000	1.8			
95	01/05/94	HI-82	Wellfield	1,250	1.8			
96	01/08/94	JI-38	Wellfield	1,000	1.6			
97	01/15/94	JI-22	Wellfield	2,250	15.1			
98	02/08/94	HI-137	Wellfield	2,000	9.7			
99	02/23/94	JI-80	Wellfield	1,100	7.9			
100	04/29/94	JI-27	Wellfield	1,200	12.7			
101	07/29/94	R.O. feed from pond RA	Pond	3,000	17.8			
102	08/01/94	South side of plant	Yellowcake	509				
103	08/15/94	Plant Annex	Process	1,000	159.4		196.00	5.9
104	10/13/94	Linde Building	Wellfield	6,000	1.5		2.40	1.1
105	11/16/94	JP-60	Wellfield	4,500	10.0			
106	11/30/94	Unit 7 Trunkline	Wellfield	1,000	1.1			
107	12/06/94	Unit 7, Trunkline 16	Wellfield	6,250	1.2			
108	12/10/94	Unit 8 Trunkline 8	Wellfield	5,000	0.2		2.30	2.1
109	12/10/94	JP-64	Wellfield	1,200	12.9		10.60	2.5
110	12/12/94	Unit 7Trunkline 3	Wellfield	5,000	7.0		2.90	2.3
111	12/15/94	KI-100B	Wellfield	2,500	12.0			
112	01/02/95	LP-41B	Wellfield	1,000	7.5			
113	01/11/95	LI-16	Wellfield	1,000	8.7			
114	01/16/95	Unit 9 Mod.	Wellfield	9,000	1.6			
115	01/17/95	JI-83	Wellfield	200	7.3			
116	01/17/95	JP-44	Wellfield	500	7.3			
117	01/17/95	JI-104	Wellfield	1,000	1.6			
118	01/18/95	KI-113B	Wellfield	1,000	8.7			
119	01/24/95	Unit 7, Recovery line #8	Wellfield	1,000	8.1			
120	02/01/95	Unit 6, Trunkline #8	Wellfield	1,000	2.6			
121	05/17/95	Unit 6 Trunkline	Wellfield	1,000	4.3			
122	07/07/95	Pond B	Process	9,000	17.8			
123	07/27/95	Plant Annex	Process	1,000	26.7		1315.00	4.6
124	08/01/95	Pond B	Process	1,500	8579.0		550.00	5.3
125	08/18/95	KI-96	Wellfield	5,000	8.4			
126	02/09/96	Unit 5 trunkline	Wellfield	3,000	8.8			
127	05/20/96	Unit 7 trunkline	Wellfield	500	10.6			
128	06/06/96	Pond D	Process	3,000	21.8	1730		1.9 - 12.4
129	08/01/96	Pond D	Pond	500	10.1			
130	08/09/96	Pond D	Process	1,000	15.6			
131	12/06/96	Pond RA	Pond	1,000	146.0		13.20	<1.3
132	12/06/96	R.O. Plant feed line.	Wellfield	2,000	<0.2			

133	12/06/96	T3	Wellfield	800	8.4			
134	12/09/96	Rec. Riser	Wellfield	2,000	6.9		8.30	3.5
135	04/22/97	Pond RB	Process	59,400	237.7		38.40	1.4
136	05/21/97	GP-23	Wellfield	1,000	2.0			
137	06/21/97	GI-112	Wellfield	2,000	5.0			
138	06/24/97	Pump House	Wellfield	1,500	<0.4			
139	07/12/97	GI-129	Wellfield	5,000	0.7		3.50	2.0
140	09/13/97	GI-112	Wellfield	2,000	4.5			
141	09/16/97	RA Trans. Line	Pond	2,240	78.5		18.20	3.8
142	10/20/97	GP-11	Wellfield	1,000	<0.4			
143	10/26/97	GI-96B	Wellfield	430	6.2		10.50	6.0
144	10/26/97	GI-141	Wellfield	1,000	3.4		14.70	10.5
145	11/05/97	GI-84	Wellfield	50	6.1		2.15	1.2
146	11/05/97	GI-22	Wellfield	50	5.4		2.71	1.4
147	11/17/97	HP-75	Wellfield	1,000	4.4		19.00	48.7
148	12/26/97	GP-56	Wellfield	2,000	3.2			
149	01/06/98	GI-17	Wellfield	150	5.1			
150	01/06/98	GI-14	Wellfield	300	5.0		0.21	2.7
151	02/18/98	HP-87	Wellfield	3,000	3.2		0.073	1.4
152	04/04/98	GP-30	Wellfield	150	5.6			
153	09/07/98	GP-14	Wellfield	2,000	2.3			
154	09/09/98	GP-44	Wellfield	3,000	2.2			
155	09/10/98	517 ponds	Pond	150	159.8			
156	09/16/98	GI-51	Wellfield	4,000	2.2			
157	09/17/98	GI-106	Wellfield	1,700	2.0			
158	09/18/98	LI-123	Wellfield	1,200	2.9			
159	09/19/98	GP-23	Wellfield	2,000	3.0			
160	09/25/98	FP-29	Wellfield	3,000	2.5			
161	12/25/98	LI-59	Wellfield	700	10.5			
162	12/25/98	LP-25	Wellfield	700	8.8			
163	02/12/99	LP-26	Wellfield	1,000	3.6			
164	03/17/99	Unit 7 trunkline	Wellfield	3,000	4.2			2.1
165	04/03/99	Unit 9 Trunkline	Wellfield	13,000	<0.4		6.27	10.3
166	04/08/99	LP-22	Wellfield	1,000	3.8		6.05	1.0
167	04/15/99	KI-34	Wellfield	200	6.2		7.85	4.3
168	04/15/99	LI-84	Wellfield	1,000	0.4		7.85	4.6
169	06/14/99	LI-73	Wellfield	1,000	6.7		8.84	2.7
170	08/15/99	KI-88	Wellfield	5,000	2.6		7.11	3.7
171	10/29/99	Pond RB	Pond	200	89.2		16.30	1.2
172	02/08/00	JI-80	Wellfield	1,500	6.9		8.07	21.4
	03/03/00	LI91	Wellfield					
173	03/25/00	Ki-156	Wellfield	500	5.0		17.80	40.2
174	04/19/00	KI-62	Wellfield	3,000	7.2			
175	07/19/00	Unit 6 Trunkline	Wellfield	450	6.9			
176	9/10/2001	HI81	Wellfield		2.0			
177	3/4/2004	POND RB		15,000	3.2			
178	5/19/2004	POND B		1,200	989.6			

TABLE 1.2 CHRISTENSEN RANCH PROJECT SPILLS

See the Christensen Ranch Project - General Location and Spill Map for spill locations sites.

					Spill Solution (mg/l)		Soil Sample (pCi/g)	
Number	Date	Location	Spill Solution	Volume (Gallons)	Uranium as U308	Ra226	Uranium as U	Ra226
1	04/14/89	Access road between sites. Not shown on spill maps.	Yellowcake Slurry	< 55				
2	06/27/89	Mod. 3-4	Wellfield	2,500				
3	08/04/89	Mod. 3-3	Wellfield	1,500				
4	08/29/89	3C19-1	Wellfield	1,000				
5	03/06/90	R.O. Brine discharge	Process	2,126	2.5			
6	04/23/90	CR-1 pond	Pond	1,000				
7	05/03/91	MU3 Extension	Wellfield	4,500	0.2			
8	09/08/92	Mod. 3-4	Wellfield	1,000				
9	09/29/92	200' north of plant	Wellfield	14,000	1.0		1.90	2.7
10	03/05/93	Mod. 2-1	Wellfield	5,400	0.1			
11	03/24/93	Unit 2 trunkline (MW87)	Wellfield	10,000	1.3		1.09	2.2
12	04/04/93	Mod. 2-2	Wellfield	7,500	0.9		5.40	1.2
13	05/09/93	Mod 2-1	Wellfield	5,400	0.9		2.00	1.3
14	05/15/93	Unit 2-3 trunkline	Wellfield	30,000	1.9		1.50	1.2
15	07/18/93	2AH27-1	Wellfield	1,000	1.2			2.1
16	10/23/93	Mod 3-1	Wellfield	2,000	2.1			
17	01/02/94	2W47-1	Wellfield	1,500	1.3			
18	01/20/94	2AF23-2	Wellfield	7,500	2.1			6.0
19	06/22/94	Unit 4 pump station	Wellfield	1,000	0.5			
20	07/14/94	Mod. 4-2	Wellfield	2,500	235.0		36.10	3.4
21	07/20/94	Pond backwash line	Pond	3,400	21.7			
22	12/04/94	4M34-1	Wellfield	40,000	0.8			
23	04/07/95	Mod. 3-1	Wellfield	400	21.5			
24	04/11/95	Mod. 4-3	Wellfield	12,000	0.5	339.7	0.4 - 1.7	0.9 - 2.3
25	06/26/95	5AK62-2	Wellfield	5,000	50.0		22.00	2.2
26	06/27/95	5AM72-3	Wellfield	500	58.0		14.10	24.0
27	07/07/95	Mod 3-3 Manhole	Wellfield	2,000	2.1			
28	01/01/96	Mod. 5-1 Building	Wellfield	4,000	1.0			
29	01/10/96	Unit 4 pump station	Wellfield	1,000	1.0			
30	01/15/96	5AU57-1	Wellfield	20,000	1.4		2.70	<0.6
31	01/14/96	5BE47-2	Wellfield	7,200	0.5			
32	02/11/96	5AU51-1	Wellfield	1,000	0.5			
33	02/16/96	5AV57-1	Wellfield	1,000	1.0			
34	02/29/96	Mod. 3-1 Building	Wellfield	1,000	36.7		9.40	<0.6
35	03/04/96	5AM69-1	Wellfield	1,000	1.1			
36	03/10/96	5BC53-2	Wellfield	6,350	0.8			
37	03/14/96	5TW-02	Wellfield	1,000	2.0			
38	03/17/96	5AU47-1	Wellfield	6,000	N/A			
39	05/08/96	5BI43-1	Wellfield	1,500	N/A			
40	05/22/96	5BK43-1	Wellfield	1,000	0.7			
41	06/07/98	5BJ61-1	Wellfield	1,000	1.0		2.50	3.1
42	06/18/96	5BK51-2	Wellfield	1,500	30.5		11.7-23.4	2.8 -6.3
43	07/28/96	Unit 4 Pump Station	Wellfield	2,000	N/A		0.90	2.3
44	09/01/96	5BH45-1	Wellfield	2,000	2.2		1.90	2.5
45	11/07/96	Mod. 3-3 Manhole	Wellfield	4,600	1.4			
46	12/02/96	5AU57-1	Wellfield	14,600	1.0			
47	01/10/97	Mod. 6-1, Inj. Trunkline	Wellfield	1,900	1.1		4.20	20.1
48	01/27/97	5BK48-2	Wellfield	2,300	30.4		5.40	1.7
49	01/29/97	6 Pump Station Manhole	Wellfield	9,000	0.7		1.20	1.2
50	02/28/97	5BG65-1	Wellfield	6,012	0.2		3.10	3.2
51	05/17/97	Mod.3-2, Manhole	Wellfield	60,000	0.7			8.0
52	05/17/97	5BH64-1	Wellfield	300	13.1		7.90	<1.8
53	07/24/97	Mod. 6-2	Wellfield	700	30.0		3.58	2.0
54	08/19/97	Mod. 6-3	Wellfield	3,280	2.0		0.69	0.7
55	11/19/97	6AO49-2	Wellfield	<400	40.2			
56	01/13/98	6AM47-3	Wellfield	1,000	1.5			
57	05/11/98	6AC38-1	Wellfield	4,125	0.8		1.12	1.1
58	05/14/98	5AV55-1	Wellfield	107,826	1.1	<0.2	1.83	7.4
59	07/08/98	5AV55-1	Wellfield	28,213	2.0		1.73	4.5
60	8/31/98	6AL48-2	Wellfield	3,000	1.7			
61	09/18/98	6AO59-1	Wellfield	1,000	0.8			

TABLE 1.2 CHRISTENSEN RANCH PROJECT SPILLS

See the Christensen Ranch Project - General Location and Spill Map for spill locations sites.

					Spill Solution (mg/l)		Soil Sample (pCi/g)	
62	12/14/98	5AM80-1	Wellfield	4,500	20.1			
63	03/26/99	Mod. 3-1 Building	Wellfield	23,520	1.2		3.12	3.8
64	03/29/99	3HI17-1	Wellfield	60,918	<0.4		2.12	46.5
65	04/12/99	6V27-1	Wellfield	32,400	0.9		3.22	2.9
66	05/03/99	5BK82-1	Wellfield	2,650	1.6		28.80	48.8
67	05/07/99	5BD47-1	Wellfield	14,910	1.8		2.28	1.5
68	05/12/99	3L29-1	Wellfield	1,000	<0.4		5.98	32.7
69	07/13/99	5BN162-2	Wellfield	3,780	19.3		8.79	2.9
70	10/04/99	6AI69-3	Wellfield	400	72.2		17.30	2.1
71	05/01/00	DDW#1	Process	2,000	0.6		2.22	1.5
72	7/12/2002	PLANT			11.4			
73	10/16/2002	MOD 43	Wellfield		5.5			
74	4/28/2003	2 PUMP STATION	Wellfield	<1000	<.4			
75	4/30/2003	2 PUMP STATION	Wellfield	1,200				
76	9/24/2003	3MW53D	Wellfield	420	<.4			
77	11/4/2003	2X60-1	Wellfield	325	<.4			
78	11/15/2003	6AL49-1	Wellfield	300	27.6			
79	12/16/2003	DDW#1		420	<.4			
80	12/31/2003	MOD42 TRUNKLINE	MANHOLE	2,300	6.7			
81	1/16/2004	AM12-2	MOD 41	3,179	5.6			
82	4/25/2004	DDW#1 TANK BUILDING		<400	1.1			
83	5/20/2004	POND 3		900	12.5			

COGEMA Mining, Inc., Christensen Ranch Summary of Excursions 12/17/2009

DATE / YEAR	MINE UNIT#	WELL I.D.	DATE ON EXCURSION		DATE OFF EXCURSION
1992	3	MW 48S	6/16/1992		No Data
1993	3	MW 46S	3/7/1993		No Data
1995	2	MW 108	1/9/1995		2/9/1995
1995	4	MW 15	6/8/1995		No Data
1996	3	MW 46S	1/25/1996		4/8/1996
1997	5	MW 52	1/2/1997		2/7/1997
1997	5	MW 16	3/13/1997		4/15/1997
1997	3	MW 64	5/16/1997		7/9/1997
1997	2	MW 89	5/16/1997		7/9/1997
1998	6	MW 46	3/5/1998		4/1/1998
1998	6	MW 40	12/23/1998		1/12/1999
1998	3	MW 46S	9/2/1998		2/3/1999
1999	2	MW 89	10/8/1999		6/5/2000
1999	6	MW 21	10/28/1999		12/6/1999
2001	5	MW 43	3/22/2001		4/12/2001
2001	5	MW 66	8/21/2001		1/15/2002
2002	5	MW 8	12/16/2002		7/28/2003
2003	2	MW 68S	3/3/2003		4/16/2003
2003	5	MW 54	5/21/2003		9/22/2003
2003	2	MW 68S	12/2/2003		2/3/2004
2004	5	**MW 66**	7/21/2004		
2005	5	**MW 66**	7/21/2004		
2006	5	**MW 66**	7/21/2004		
2007	5	**MW 66**	7/21/2004		
2007	5	MW 48	4/25/2007		5/23/2007
2007	4	MW 1	9/5/2007		9/27/2007
2008	5	**MW 66**	7/21/2004		
2008	4	MW 1	3/10/2008		4/3/2008
2008	2	MW 89	3/11/2008		6/10/2008
2008	5	MW 48	4/15/2008		5/15/2008
2009	5	**MW 66**	7/21/2004		
2009	2	MW 89	3/11/2009		7/27/2009
2009	4	4MW 1	9/15/2009		10/15/2009
2009	2	MW 89	12/16/2009		

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R. BARTON, CLERK
DISTRICT COURT, DUVAL COUNTY TEXAS
BY: _____ DEPUTY

CAUSE NO. 16264

MANUEL T. LONGORIA, individually and as trustee for MARIA A. LONGORIA GST EXEMPT TRUST	§	IN THE DISTRICT COURT
vs.	§	DUVAL COUNTY, T E X A S
URANIUM RESOURCES, INC., URI, INC., and WILLIAM M. MCKNIGHT, SR.	§	229TH JUDICIAL DISTRICT

PLAINTIFF'S ORIGINAL PETITION

TO THE HONORABLE JUDGE OF SAID JUDGE:

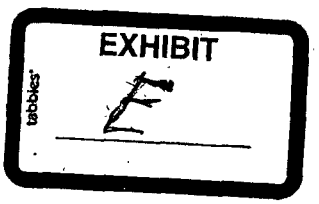
MANUEL T. LONGORIA, individually and as trustee for MARIA A. LONGORIA GST EXEMPT TRUST, files his Original Petition complaining of URANIUM RESOURCES, INC., URI, INC., and WILLIAM M. MCKNIGHT, and would show the Court as follows:

I.

MANUEL T. LONGORIA, (hereinafter referred to as "Plaintiff), is a natural person residing at 1408 Mier, Laredo, Webb County, Texas 78040. He is the sole Trustee for the MARIA A. LONGORIA GST EXEMPT TRUST. Said Plaintiff owns the property , both individually and as Trustee, made subject to this suit.

Defendant URANIUM RESOURCES, INC., is a Delaware corporation with its principal place of business in Dallas, Dallas County, Texas. URANIUM RESOURCES, INC. may be served with process through Thomas Ehrlich, 12750 Merit Drive, Suite 1210, Lock Box 12, Dallas, Dallas County, Texas 75251.

Defendant URI, INC., is a Delaware corporation with its principal place in Dallas, Dallas County, Texas. URI, INC. is a wholly-owned subsidiary of URANIUM RESOURCES, INC. URI, INC. may



also be served with process through Thomas Ehrlich, 12750 Merit Drive, Suite 1210, Lock Box 12, Dallas, Dallas County, Texas 75251.

Defendant, WILLIAM M. MCKNIGHT, SR., is a natural person, resident of Nueces County, Texas, who may be served with process at URI, INC., 5656 South Staples, Suite 250, LB 8, Corpus Christi, Texas 78411.

II.

Venue is proper in Duval County pursuant to Tex. Civ. Prac & Rem. Code § 15.001 because all or part of Plaintiff's causes of action accrued in Duval County.

III.

Defendants, URANIUM RESOURCES, INC. and URI, INC., for many years engaged in uranium mining and processing operations on ranch property owned by Plaintiff, pursuant to a mineral lease with Plaintiff, as well as on property immediately adjacent to Plaintiff's land. As a result of these uranium mining and processing operations, URANIUM RESOURCES, INC. and URI, INC., have, on many occasions, released toxic chemicals and/or radioactive materials onto Plaintiff's land polluting the soil, aquifer, and vegetation of Plaintiff's Ranch, in violation of Texas law and said Defendants' contractual obligations to Plaintiff.

IV.

Plaintiff would further aver that Defendant WILLIAM R. MCKNIGHT in the events giving rise to this suit, is a person who had supervisory and management authority over the uranium

operations in question, including such a degree of control that would have enabled him, in the exercise of ordinary care, to properly protect the Plaintiff from the injuries and damages suffered by Plaintiff in the events giving rise to this suit.

Plaintiff would assert and allege that the cause or causes of action herein arose from or are connected with purposeful acts committed by said Defendant.

V.

Plaintiff MANUEL T. LONGORIA is the owner and trustee of the property which is the subject of this suit. The property is a ranch located in Duval and Webb Counties. In the late 1970's Plaintiff leased the rights to mine for uranium on portions of his Ranch to Defendants, URANIUM RESOURCES, INC., AND URI, INC., who thereafter engaged in uranium mining and processing operation on Plaintiff's land at all times relevant herein. During the course of said Defendants' Uranium mining and processing operations on Plaintiff's Ranch, and on adjacent land, Defendants URANIUM RESOURCES, INC. and URI, INC. (hereinafter collectively referred to as "URI"), wrongfully discharged excessive and hazardous materials onto Plaintiff's property, contaminating the soils, aquifer, and vegetation on his Ranch, and creating a serious health hazard thereon. Despite the Defendants' knowledge that URI's activities were contaminating Plaintiff's property, they completely failed to inform Plaintiff of the pollution, and instead constantly assured him that URI's activities were doing no harm. Plaintiff did not learn of the pollution and contamination of his property until only

recently. The contamination has damaged the value of the property, preventing Plaintiff's use and enjoyment of the property, and has become a substantial toxic health hazard.

VI.

URI's Uranium mining and processing operations on Plaintiff's Ranch (hereinafter referred to as the "Longoria Ranch"), and the adjacent property, first began in 1979. URI mined the Uranium through in-situ solution mining, a process which contaminated the soil, aquifer, and vegetation on Plaintiff's land with toxic materials and hazardous waste.

VII.

URI also discharged massive amounts of wastewater into the Arroyo de los Angeles in its uranium mining and processing operations, both on the Longoria Ranch and on adjacent property, including discharging directly into an extremely rare and attractive natural spring fed pool in the Arroyo that was used for swimming and fishing. As a result, portions of property owned by Plaintiff, including the Arroyo spring, and the Arroyo meadows, is contaminated with hazardous materials and hazardous waste.

VIII.

Defendant MCKNIGHT represented to Plaintiffs that the discharge onto the Arroyo de Los Angeles from URI's mining operations would consist of water cleaner than typical City drinking water, and convinced Plaintiff to allow for such discharge, when said Defendant knew that in fact the Arroyo would be contaminated with massive amounts of wastewater laden with

hazardous materials.

IX.

The Arroyo de los Angeles on the Longoria Ranch property in Duval County is now polluted with dangerous chemicals. These chemicals were deposited by discharges onto the Arroyo. Such contamination was caused by URI and has damaged the value of Plaintiff's property, prevented use of the property, and has created a serious health hazard which has resulted in the need for extensive remediation of the affected soil, aquifer, and vegetation.

X.

Other property on the Longoria Ranch, including the uranium mine fields operated by URI, and property on which URI's uranium processing facilities were located, were contaminated with hazardous materials and dangerous chemicals as a result of the uranium mining activities of URI. Such contamination was caused by URI and has damaged the value and use of Plaintiff's property, and has created a serious health hazard which has resulted in the need for extensive remediation of the affected soil, aquifer, and vegetation.

XI.

Following the cessation of its solution mining operations at the Longoria Ranch, URI was asked by the State to clean-up its pollution. Plaintiff subsequently also requested of URI that it remediate the property. URI has failed to comply.

XII.
NEGLIGENCE
AND GROSS NEGLIGENCE

Defendants owed a duty of reasonable care to Plaintiff to ensure that its activities on Plaintiff's property did not injure or damage Plaintiff. Defendants breached this duty of care through acts and omissions including but not limited to:

1. Failing to adequately and safely conduct mining operations;

2. Failing to adequately and safely conduct uranium processing operations;

3. Failing to adequately and properly conduct mining restoration activities;

4. Failing to dispose of wastewater in an adequate and proper manner;

5. Failing to choose a safe and adequate location for its wastewater discharge;

6. Failing to conduct accurate, timely and frequent testing of chemicals in its wastewater stream;

7. Failing to conduct accurate, timely and frequent testing of chemicals in the soil at its wastewater discharge locations;

8. Failing to properly investigate and take appropriate action when notified of contamination by the State;

9. Misinforming the Plaintiff and the public of the scope and nature of contamination on the Longoria Ranch;

10. Failing to take timely and appropriate actions to clean-up the contamination on the Longoria Ranch;

11. Failing to comply with the State of Texas regulations regarding limits for chemical contamination of soil and water;

12. Failing to comply with State of Texas regulations regarding the frequency of testing for chemicals in its wastestream, and in the soil;

13. Failing to take adequate corrective measures when it

knew or should have known that its activities were polluting and contaminating Plaintiff's property;

14. Failing to warn Plaintiff of the potential contamination of his property;

15. Failing to notify Plaintiff of the contamination of his property.

Defendants' negligent acts and omissions were and are a proximate cause of injuries and damages to Plaintiff.

XIII.
NEGLIGENCE PER SE

URI's wastewater disposal caused contamination and pollution of Plaintiff's property in excess of the pollution threshold limits defined in Texas law.

XIV.
BREACH OF CONTRACT

Plaintiff entered into a Uranium mining lease with R.L. Burns Corp. on August 10, 1977. This lease was subsequently assigned by R.L. Burns Corp. to URI. URI breached the lease through its improper, inadequate, and unsafe conduct in its uranium mining and processing operations, including the disposal of polluted wastewater onto the Longoria Ranch which contaminated Plaintiff's soil, aquifer, and vegetation with toxic and radioactive materials, and other unsafe uranium mining and processing activities, all of which contaminated Plaintiff's land; and further breached the lease in failing to remediate Plaintiff's contaminated land to its original condition. Furthermore, URI has failed to pay any compensation whatsoever to Plaintiff for the damage to his property. URI's breaches of its agreements with Plaintiff have

damaged and injured Plaintiff beyond the jurisdictional limits of the Court.

XV.
FRAUD

Prior to entering into the original Uranium lease with Plaintiff, as well as the subsequent wastewater pipeline easement agreement, URI and MCKNIGHT made false material representations to Plaintiff regarding the environmental impact of URI's operations on Plaintiff's property. URI and MCKNIGHT told Plaintiff that its operations were clean, safe, and well-regulated and would not affect Plaintiff's property or its value. When URI and MCKNIGHT made these representations, they knew they were false, or in the alternative, made them recklessly without any knowledge of their truth as a positive assertion. URI and MCKNIGHT made false representations with the full intent that Plaintiff rely upon them in order to encourage Plaintiff to enter into a Uranium mining lease with URI and to allow URI and MCKNIGHT to discharge wastewater into the Arroyo de Los Angeles. Based upon URI's and MCKNIGHT'S representations that its activities would not contaminate or pollute his land, Plaintiff entered into the lease with URI and allowed the discharge of waste water into the Arroyo, through a pipeline easement, and has thereby suffered substantial and severe injuries and damages.

XVI.
NUISANCE

URI's pollution and contamination of the soil, aquifer, and vegetation of Plaintiff's ranch has unreasonably interfered with

Plaintiff's use and enjoyment of his land. URI's conduct was a result of its intentional or negligent wrongdoing. Such wrongdoing as plead elsewhere in this petition is incorporated into this section by reference. URI's interference with Plaintiff's use and enjoyment of his land has caused Plaintiff significant and substantial harm.

XVII.
TRESPASS

URI's dumping of toxic and radioactive materials on Plaintiff's property through its wastewater discharge constituted an unauthorized physical entry on the property. It was URI's full intention to dispose of the wastewater on Plaintiff's property, and such disposal was done voluntarily. As a result of the unauthorized entry of URI's toxic materials on his ranch, Plaintiff has suffered significant and substantial injuries and damages.

XVIII.
INTENTIONAL INFLICTION OF EMOTIONAL DISTRESS

URI's pollution of Plaintiff's property, its efforts to conceal the contamination from Plaintiff, and its attempt to abandon the contaminated area prior to clean-up demonstrate extreme and outrageous conduct by URI. Such conduct was undertaken intentionally or recklessly by URI, and caused Plaintiff to suffer severe emotional distress as a result.

XIX.
DAMAGES

As a direct and proximate cause of URI's wrongful acts and omissions, Plaintiff has been severely injured and damaged. Such

injuries and damages include the following:

1. Personal discomfort, annoyance, and inconvenience for damage to Plaintiff's ranch property;

2. Loss of the productivity of Plaintiff's ranch property;

3. Loss of the use of Plaintiff's property;

4. Loss of the value of Plaintiff's property;

5. Lost rental value of the property;

6. Loss in the value of Plaintiff's livestock;

7. Cost of restoring the Ranch to the condition it was in prior to Defendant's activities, including restoring the soil, aquifer, and vegetation to its prior condition;

8. Damage to the property, to the underground aquifers, and injury to vegetation by past and future restoration activities;

The Plaintiff's injuries and damages are in an amount greatly in excess of the minimum jurisdictional requirements of this Court.

Plaintiff also requests that the Court require URI to specifically perform its obligations with Plaintiff, and with the State of Texas, to restore the land, including, without limitation, the soil, aquifer, and vegetation Defendants contaminated to the condition it was in prior to URI's mining activities.

XX.
PUNITIVE DAMAGES

Defendants' conduct that resulted in the pollution and contamination of Plaintiff's property was fraudulent, malicious, and grossly negligent. It further demonstrated conscious indifference to the rights and welfare of the Plaintiff. Plaintiff is entitled to punitive damages because Defendants intentionally made false statements to Plaintiff concerning the environmental

effect of URI's mining and restoration activities. Defendants knew of the falsity of its statements and made them intentionally to deceive Plaintiff or with heedless and reckless disregard of the consequences of their statements.

Plaintiff is further entitled to punitive damages because Defendants' conduct demonstrates malice. Defendants polluted and contaminated the Longoria Ranch, concealed the degree of contamination from Plaintiff, and attempted to deceitfully claim that there was no contamination. Defendants carried out these acts with flagrant disregard for the rights of Plaintiff and with actual awareness that their acts would in reasonable probability result in damage to Plaintiff's property.

Plaintiff is also entitled to punitive damages because of Defendants' gross negligence. Defendants' conduct that resulted in the pollution and contamination of Plaintiff's property demonstrated such an entire want of care that it reflects a conscious indifference to the rights, and welfare of Plaintiff. Defendant's activities on the ranch involved an extreme degree of risk of harm to the Plaintiff. Defendants knew of the risk involved, but nevertheless proceeded with its wrongful activities with conscious indifference to the rights, safety, and welfare of Plaintiff.

XXI.
DISCOVERY RULE

The Discovery Rule applies to this matter. No limitation begins to run until Plaintiff learned of, or in the exercise of reasonable diligence, should have learned of Defendants' misconduct

herein complained of. Plaintiff brought suit promptly after learning of the existence of facts constituting the causes of action herein pleaded. Any suggestions that in the exercise of reasonable diligence that Plaintiff should have discovered Defendants' misconduct earlier in incorrect. Accordingly, the defenses of limitations, latches, estoppel or ratification do not apply.

XXII.
ATTORNEY'S FEES

Because of Defendant's wrongful acts and omissions, Plaintiff has had to hire the below signed attorneys to prosecute this suit on his behalf. Plaintiff thereby will incur liability for the usual, customary and reasonable fees for the attorneys' services in the prosecution of the claim. If Plaintiff is successful in the prosecution of his Breach of Contract and Punitive Damages claims, he is entitled to recover the reasonable and necessary attorneys' fees he has incurred.

XXII.
PRAYER

WHEREFORE, PREMISES CONSIDERED, Plaintiff prays that Defendants be cited to answer and appear herein and that, upon final trial hereof, Plaintiff recover judgment against Defendants for damages, exemplary damages, costs, pre-judgment interest, post-judgment interest, attorneys fees, and all such other and further relief at law and equity to which they may show themselves justly entitled.

Respectfully Submitted,

Ricardo de Anda
Laura L. Gomez
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212 Flores Avenue
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Fax. (210) 726-0030

Robert J. Binstock
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By: _____
Ricardo de Anda
State Bar No. 056895000

Attorneys for Plaintiff

PLAINTIFF REQUESTS TRIAL BY JURY.

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April 4, 1997

Mr. Dale P. Kohler, Leader
Inspection and Compliance Team
UIC, Uranium, and Radioactive Waste Section
TNRCC
P O Box 13087
Austin, Texas 78711-3087

RE: Permit #1989

Dear Mr. Kohler:

As you may recall, I represent Mr. Manuel Longoria, the owner of the property subject to the above Permit issued by your office.

In response to URI's request that the property be released from URI's Permit requirements, URI took samples of soil from the Arroyo de Los Angeles in November, and again in December of 1996, to determine the extent of uranium contamination of the Arroyo caused by its long-standing discharge of contaminated wastewater into the Arroyo on the Longoria Ranch. URI had the samples analyzed by Jordan Labs. We took split samples of the December soil retrievals and had them analyzed by Teledyne labs. I take it that URI has forwarded you copies of Jordan's lab analysis. I am enclosing herewith copies of Teledyne's lab analysis.

I have attached hereto two tables setting out the more relevant data regarding the lab results. On Table I, I have compared URI's results from the November 1996 retrievals, with the results which they obtained from an analysis which they undertook in 1994. I believe you have a copy of the 1994 results. On Table 2, I have compared URI's results from the December 1996 retrievals as reported by Jordan Labs, with our split sample results as reported by Teledyne Labs.

It is evident from Table I that of the 20 samples taken downstream from the discharge point, 19 of the samples exhibit uranium contamination substantially above background levels, and 8 of the samples indicate contamination above the State's limits for releasing a permittee from its obligations. Moreover, 14 of the 20 samples taken in November of 1996 exhibited an increase in

levels of contamination from URI's 1994 tests. For example, several locations that were below legal limits in 1994 rose to above legal limits in November of 1996. Indeed, Table 1 shows that uranium is moving after each rainstorm, and that levels that are decontaminated today will likely become recontaminated later, unless extensive decontamination is undertaken to remove all vestiges of uranium above background.

While Table 1 shows that measurements upstream, at the boundary of the Longoria-Cogema leased property, are below the legal limit, uranium concentrations are four times above background. Moreover, the uranium concentrations recorded from the November 1996 retrievals are above those measured in 1994, and indicate uranium is moving downstream from the URI discharge point on property owned by Servando Benavides. This shows that uranium from the URI/Benavides discharge point has not only contaminated the Cogema leased stretch of the Arroyo, but is also moving onto the Longoria Ranch. URI should thus not be relieved of its permit obligations until the Longoria property is completely remediated, and until leakage from the URI/Benavides discharge point and the Cogema leased property is resolved as well.

While Table 1 shows that uranium concentrations further down the Arroyo on Longoria property are not above legal limits, they are still significantly above background levels, and there is no question uranium has moved more than 3/5 of a mile downstream to the border of the Longoria property, and undoubtedly onto neighboring properties.

Finally, we are concerned with the understated results reported by URI, when compared with our split sample report from Teledyne labs. URI soil concentration of uranium results reported by Jordan Labs are consistently lower when compared to the Teledyne Lab results, as shown on table 2. This is probably explained by the fact that the laboratory methods of measurement are different. Teledyne uses a more precise method, dissolving the uranium in acid first. We believe that this suggests that most of the URI samples reported on Table 1 as being below legal limits, are understated, and should be considered as being in fact above limits.

We submit that the whole stretch of the Arroyo from the URI/Benavides discharge point until it leaves the Longoria Ranch needs to be decontaminated before URI is discharged from its permit obligations. Moreover, we have concern about URI's proposed method for remediation. URI wishes to simply remove contaminated soil. We fear that unless your office directs an independent monitoring of the work, URI could simply mix surface uranium where concentrations are higher in with deeper arroyo soils so that the resultant concentrations are below regulatory limits without actually moving uranium out of the arroyo. This is hardly remediation. A remediation plan should be required of URI which is designed to effectively and permanently decontaminate the Arroyo, and safely dispose of the contaminated soils in a validated manner.

Please advise as to your response to this letter before you take action on URI's request for release from its permit obligations, specifically providing us with any proposed remediation plan, so that we may be provided with an opportunity to comment on how you intend to provide for the required remediation.

Thank you.

Sincerely yours,

Ricardo de Anda

RDA/lbv

ARROYO DE LOS ANGELES SOIL
TABLE 1. URI ANALYSIS COMPARISON

NATURAL U (PPM AVERAGES)

URI '94		URI '96	
Location		Location	
LG100	0.93		1
LG200	0.93		1
LG300	0.93		1.2
LG400	1		1.2
LG500	1.1		1
LCK0	38	LCK50	24
LCK100	16	LCK150	71
LCK200	34	LCK250	47
LCK300	14	LCK350	7.6
LCK400	30	LCK450	48
LCK500	35	LCK550	54
LCK600	33	LCK650	100
LCK700	53	LCK750	36
LCK800	20	LCK850	24
LCK900	34	LCK950	39
LCK1000	34	LCK1050	58
LCK1100	43	LCK1150	40
LCK1200	25	LCK1250	18
LCK1300	12	LCK1350	14
LCK1400	37	LCK1450	70
LCK1500	37	LCK1550	47
LCK1600	27	LCK1650	27
LCK1700	11	LCK1750	12
LCK1800	10	LCK1850	25
LCK1900	10	LCK1950	20
LCK2000	20	LCK2050	17

Note: URI '96 samples taken November 19, 1996, at LCK 50, 150, 250, etc., while URI '94 samples taken at LCK0, 100, 200, etc. URI '94 results were apparently taken 75' beyond the LCK designation.

ARROYO DE LOS ANGELES SOIL
TABLE 2. TOTAL TELEDYNE V. URI

	MAXIMUM		AVERAGE	
Location	Teledyne	URI	Teledyne	URI
LCK 50	100	66	27.5	20.68
LCK 650	69	64	41.2	35.8
LCK 1550	48	44	17.54	22.82
LCK 2850	19	20	8.46	9.94
LG 50	1.5	1	1.28	0.82
LG 150	1.3	1	1.14	0.896
LG 550	1.5	1.2	.24	0.936

Note: URI, Teledyne split samples taken Dec. 3, 1996. "Average" designations include an average compilation of the 5 samples taken across the Arroyo at the designated points. "Maximum" designations include the maximum determination found between the 5 samples taken across the designated points.

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

REPORT OF ANALYSIS

RUN DATE 01/21/97

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MR RICARDO DE ANDA
DE ANDA LAW FIRM
PLAZA DE SAN AGUSTIN
212 FLORES AVENUE
LAREDO TX 78040

S O I L

TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	START TIME	STOP DATE	STOP TIME	NUCLIDE	ACTIVITY (PCI/GM DRY)	NUCL-UNIT-% U/M *	MID-COUNT TIME DATE	MID-COUNT TIME TIME	VOLUME - UNITS ASH-WGHT-% *	LAB.
32271	LCK-50 A 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.0 +-0.2 E 02 PPM	*				3
							U-235	L.T. 7. E-01		01/14			4
							TH-234	3.6 +-0.4 E 01		01/14			4
							PB-214	2.8 +-0.3 E 01		01/14			4
							BI-214	2.6 +-0.3 E 01		01/14			4
							AC-228	L.T. 4. E-01		01/14			4
							PB-212	L.T. 2. E-01		01/14			4
							TL-208	L.T. 1. E-01		01/14			4
							K-40	5.1 +-0.9 E 00		01/14			4
							CS-137	1.3 +-0.6 E-01		01/14			4
32272	LCK-50 A 6-12		12/03				PREP	DISSOLVED					3
							TOTAL-U	6.4 +-1.0 E 00 PPM	*				3
							U-235	L.T. 2. E-01		01/14			4
							TH-234	3.1 +-0.6 E 00		01/14			4
							PB-214	1.2 +-0.1 E 00		01/14			4
							BI-214	1.1 +-0.1 E 00		01/14			4
							AC-228	L.T. 2. E-01		01/14			4
							PB-212	3.0 +-0.4 E-01		01/14			4
							TL-208	1.3 +-0.3 E-01		01/14			4
							K-40	5.7 +-0.6 E 00		01/14			4
							CS-137	8.7 +-3.0 E-02		01/14			4
32273	LCK-50 B 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	2.5 +-0.4 E 01 PPM	*				3
							U-235	L.T. 5. E-01		01/10			4
							TH-234	8.5 +-0.9 E 00		01/10			4
							PB-214	8.6 +-0.9 E 00		01/10			4
							BI-214	8.3 +-0.8 E 00		01/10			4
							AC-228	L.T. 3. E-01		01/10			4
							PB-212	5.2 +-0.7 E-01		01/10			4

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

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MR RICARDO DE ANDA
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32273	LCK-50 B 0-6		12/03				TL-208	1.5 +-0.5 E-01		01/10			4
							K-40	8.0 +-0.8 E 00		01/10			4
							CS-137	2.0 +-0.4 E-01		01/10			4
32274	LCK-50 C 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	2.3 +-0.3 E 00 PPM	*				3
							U-235	L.T. 2. E-01		01/10			4
							TH-234	L.T. 6. E-01		01/10			4
							PB-214	5.6 +-0.7 E-01		01/10			4
							BI-214	4.9 +-0.7 E-01		01/10			4
							AC-228	2.3 +-1.1 E-01		01/10			4
							PB-212	2.4 +-0.4 E-01		01/10			4
							TL-208	1.1 +-0.3 E-01		01/10			4
							K-40	6.2 +-0.6 E 00		01/10			4
							CS-137	9.1 +-3.1 E-02		01/10			4
32275	LCK-50 D 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	8.5 +-1.3 E 00 PPM	*				3
							U-235	L.T. 2. E-01		01/14			4
							TH-234	L.T. 7. E-01		01/14			4
							PB-214	9.3 +-0.9 E-01		01/14			4
							BI-214	8.8 +-0.9 E-01		01/14			4
							AC-228	L.T. 1. E-01		01/14			4
							PB-212	2.8 +-0.3 E-01		01/14			4
							TL-208	9.5 +-2.1 E-02		01/14			4
							K-40	6.9 +-0.7 E 00		01/14			4
							CS-137	1.9 +-0.3 E-01		01/14			4

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

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32276	LCK-50 E 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.7 +-0.3 E 00 PPM	*				3
							U-235	L.T. 2. E-01		01/10			4
							TH-234	7.2 +-3.3 E-01		01/10			4
							PB-214	7.2 +-0.7 E-01		01/10			4
							BI-214	6.8 +-0.7 E-01		01/10			4
							AC-228	3.4 +-0.9 E-01		01/10			4
							PB-212	3.7 +-0.4 E-01		01/10			4
							TL-208	1.3 +-0.2 E-01		01/10			4
							K-40	6.8 +-0.7 E 00		01/10			4
							CS-137	1.1 +-0.3 E-01		01/10			4
32277	LCK-650 A 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	6.9 +-1.0 E 01 PPM	*				3
							U-235	1.4 +-0.3 E 00		01/14			4
							TH-234	2.8 +-0.3 E 01		01/14			4
							PB-214	5.7 +-1.0 E-01		01/14			4
							BI-214	4.1 +-0.9 E-01		01/14			4
							AC-228	L.T. 2. E-01		01/14			4
							PB-212	3.1 +-0.6 E-01		01/14			4
							TL-208	1.2 +-0.4 E-01		01/14			4
							K-40	5.0 +-0.7 E 00		01/14			4
							CS-137	3.3 +-0.5 E-01		01/14			4
32278	LCK-650 A 6-12		12/03				PREP	DISSOLVED					3
							TOTAL-U	4.4 +-0.7 E 00 PPM	*				3
							U-235	L.T. 3. E-01		01/14			4
							TH-234	2.0 +-0.6 E 00		01/14			4
							PB-214	6.9 +-0.8 E-01		01/14			4
							BI-214	6.0 +-0.8 E-01		01/14			4
							AC-228	4.3 +-1.1 E-01		01/14			4
							PB-212	5.1 +-0.6 E-01		01/14			4

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32278	LCK-650 A 6-12		12/03				TL-208	1.8 +-0.3 E-01		01/14			4
							K-40	9.3 +-0.9 E 00		01/14			4
							CS-137	6.2 +-2.8 E-02		01/14			4
32279	LCK-650 B 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	2.2 +-0.3 E 01	PPM *				3
							U-235	L.T. 6. E-01		01/14			4
							TH-234	1.3 +-0.2 E 01		01/14			4
							PB-214	6.1 +-1.3 E-01		01/14			4
							BI-214	5.7 +-1.1 E-01		01/14			4
							AC-228	L.T. 3. E-01		01/14			4
							PB-212	3.0 +-0.7 E-01		01/14			4
							TL-208	7.7 +-4.3 E-02		01/14			4
							K-40	4.2 +-0.7 E 00		01/14			4
							CS-137	3.0 +-0.6 E-01		01/14			4
32280	LCK-650 C 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.5 +-0.2 E 01	PPM *				3
							U-235	L.T. 3. E-01		01/10			4
							TH-234	7.4 +-0.7 E 00		01/10			4
							PB-214	4.3 +-0.7 E-01		01/10			4
							BI-214	4.5 +-0.7 E-01		01/10			4
							AC-228	L.T. 2. E-01		01/10			4
							PB-212	3.6 +-0.4 E-01		01/10			4
							TL-208	1.1 +-0.4 E-01		01/10			4
							K-40	7.8 +-0.8 E 00		01/10			4
							CS-137	1.8 +-0.4 E-01		01/10			4

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32281	LCK-650 D 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	7.1 +-1.1 E 01	PPM *				3
							U-235	1.5 +-0.2 E 00		01/14			4
							TH-234	3.1 +-0.3 E 01		01/14			4
							PB-214	5.5 +-0.8 E-01		01/14			4
							BI-214	4.2 +-0.7 E-01		01/14			4
							AC-228	L.T. 2. E-01		01/14			4
							PB-212	2.9 +-0.6 E-01		01/14			4
							TL-208	7.7 +-2.9 E-02		01/14			4
							K-40	2.5 +-0.4 E 00		01/14			4
							CS-137	1.2 +-0.4 E-01		01/14			4
32282	LCK-650 E 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	2.9 +-0.4 E 01	PPM *				3
							U-235	5.2 +-2.4 E-01		01/14			4
							TH-234	1.2 +-0.1 E 01		01/14			4
							PB-214	3.0 +-0.8 E-01		01/14			4
							BI-214	4.3 +-0.8 E-01		01/14			4
							AC-228	L.T. 2. E-01		01/14			4
							PB-212	3.3 +-0.5 E-01		01/14			4
							TL-208	1.1 +-0.4 E-01		01/14			4
							K-40	4.4 +-0.5 E 00		01/14			4
							CS-137	1.8 +-0.4 E-01		01/14			4
32283	LCK-1550 A 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	4.8 +-0.7 E 01	PPM *				3
							U-235	7.9 +-1.8 E-01		01/14			4
							TH-234	1.8 +-0.2 E 01		01/14			4
							PB-214	8.3 +-0.8 E-01		01/14			4
							BI-214	6.6 +-0.7 E-01		01/14			4
							AC-228	6.2 +-1.0 E-01		01/14			4
							PB-212	7.5 +-0.8 E-01		01/14			4

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32283	LCK-1550 A 0-6		12/03				TL-208	2.8 +-0.3 E-01		01/14			4
							K-40	1.3 +-0.1 E 01		01/14			4
							CS-137	L.T. 4. E-02		01/14			4
32284	LCK-1550 A 6-12		12/03				PREP	DISSO LVED					3
							TOTAL-U	1.8 +-0.3 E 01 PPM	*				3
							U-235	5.8 +-2.0 E-01		01/14			4
							TH-234	1.1 +-0.1 E 01		01/14			4
							PB-214	6.5 +-0.7 E-01		01/14			4
							BI-214	6.7 +-0.7 E-01		01/14			4
							AC-228	5.3 +-0.9 E-01		01/14			4
							PB-212	5.7 +-0.6 E-01		01/14			4
							TL-208	2.4 +-0.3 E-01		01/14			4
							K-40	1.0 +-0.1 E 01		01/14			4
							CS-137	L.T. 3. E-02		01/14			4
32285	LCK-1550 B 0-6		12/03				PREP	DISSO LVED					3
							TOTAL-U	9.3 +-1.4 E 00 PPM	*				3
							U-235	2.8 +-1.4 E-01		01/10			4
							TH-234	5.0 +-0.6 E 00		01/10			4
							PB-214	4.1 +-0.6 E-01		01/10			4
							BI-214	4.0 +-0.6 E-01		01/10			4
							AC-228	3.0 +-0.9 E-01		01/10			4
							PB-212	3.0 +-0.4 E-01		01/10			4
							TL-208	1.2 +-0.3 E-01		01/10			4
							K-40	8.2 +-0.8 E 00		01/10			4
							CS-137	2.6 +-0.4 E-01		01/10			4

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32286	LCK-1550 C 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.4 +-0.2 E 01	PPM *				3
							U-235	9.1 +-1.7 E-01		01/10			4
							TH-234	1.3 +-0.1 E 01		01/10			4
							PB-214	6.3 +-0.6 E-01		01/10			4
							BI-214	5.9 +-0.6 E-01		01/10			4
							AC-228	5.0 +-0.9 E-01		01/10			4
							PB-212	7.0 +-0.7 E-01		01/10			4
							TL-208	2.3 +-0.3 E-01		01/10			4
							K-40	1.0 +-0.1 E 01		01/10			4
							CS-137	2.0 +-0.3 E-01		01/10			4
32287	LCK-1550 D 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	6.4 +-1.0 E 00	PPM *				3
							U-235	L.T. 3. E-01		01/10			4
							TH-234	3.5 +-1.7 E 00		01/10			4
							PB-214	4.8 +-0.7 E-01		01/10			4
							BI-214	4.6 +-0.7 E-01		01/10			4
							AC-228	L.T. 2. E-01		01/10			4
							PB-212	3.9 +-0.4 E-01		01/10			4
							TL-208	1.8 +-0.3 E-01		01/10			4
							K-40	8.4 +-0.8 E 00		01/10			4
							CS-137	1.4 +-0.3 E-01		01/10			4
32288	LCK-1550 E 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.0 +-0.2 E 01	PPM *				3
							U-235	L.T. 3. E-01		01/14			4
							TH-234	6.8 +-0.8 E 00		01/14			4
							PB-214	5.9 +-0.8 E-01		01/14			4
							BI-214	5.3 +-0.8 E-01		01/14			4
							AC-228	L.T. 2. E-01		01/14			4
							PB-212	4.0 +-0.5 E-01		01/14			4

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32288	LCK-1550 E 0-6		12/03				TL-208	1.8 +-0.4 E-01			01/14		4
							K-40	9.2 +-0.9 E 00			01/14		4
							CS-137	2.6 +-0.4 E-01			01/14		4
32289	LCK-2850 A 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.3 +-0.2 E 01	PPM *				3
							U-235	L.T. 4. E-01			01/10		4
							TH-234	9.7 +-1.0 E 00			01/10		4
							PB-214	1.8 +-0.2 E 00			01/10		4
							BI-214	1.7 +-0.2 E 00			01/10		4
							AC-228	5.8 +-1.5 E-01			01/10		4
							PB-212	1.0 +-0.1 E 00			01/10		4
							TL-208	3.0 +-0.5 E-01			01/10		4
							K-40	8.8 +-0.9 E 00			01/10		4
							CS-137	4.4 +-0.6 E-01			01/10		4
32290	LCK-2850 A 6-12		12/03				PREP	DISSOLVED					3
							TOTAL-U	7.6 +-1.4 E 00	PPM *				3
							U-235	L.T. 4. E-01			01/10		4
							TH-234	4.2 +-1.3 E 00			01/10		4
							PB-214	8.5 +-1.1 E-01			01/10		4
							BI-214	8.5 +-1.0 E-01			01/10		4
							AC-228	6.3 +-1.5 E-01			01/10		4
							PB-212	6.5 +-0.7 E-01			01/10		4
							TL-208	2.1 +-0.4 E-01			01/10		4
							K-40	1.1 +-0.1 E 01			01/10		4
							CS-137	1.5 +-0.4 E-01			01/10		4

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32291	LCK-2850 B 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.9 +-0.3 E 01	PPM *				3
							U-235	4.5 +-1.8 E-01		01/10			4
							TH-234	L.T. 1. E 00		01/10			4
							PB-214	1.1 +-0.1 E 00		01/10			4
							BI-214	9.4 +-0.9 E-01		01/10			4
							AC-228	3.2 +-0.9 E-01		01/10			4
							PB-212	7.5 +-0.8 E-01		01/10			4
							TL-208	2.0 +-0.3 E-01		01/10			4
							K-40	7.2 +-0.7 E 00		01/10			4
							CS-137	2.3 +-0.4 E-01		01/10			4
32292	LCK-2850 C 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.8 +-0.3 E 00	PPM *				3
							U-235	L.T. 2. E-01		01/10			4
							TH-234	1.1 +-0.4 E 00		01/10			4
							PB-214	4.2 +-0.5 E-01		01/10			4
							BI-214	4.1 +-0.5 E-01		01/10			4
							AC-228	3.6 +-0.8 E-01		01/10			4
							PB-212	4.2 +-0.4 E-01		01/10			4
							TL-208	1.4 +-0.2 E-01		01/10			4
							K-40	8.0 +-0.8 E 00		01/10			4
							CS-137	7.6 +-2.2 E-02		01/10			4
32293	LCK-2850 D 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	6.6 +-1.0 E 00	PPM *				3
							U-235	L.T. 2. E-01		01/10			4
							TH-234	L.T. 9. E-01		01/10			4
							PB-214	9.0 +-0.9 E-01		01/10			4
							BI-214	7.1 +-0.7 E-01		01/10			4
							AC-228	4.2 +-0.9 E-01		01/10			4
							PB-212	4.5 +-0.5 E-01		01/10			4

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32293	LCK-2850 D 0-6		12/03				TL-208	1.8 +-0.3 E-01		01/10			4
							K-40	7.5 +-0.8 E 00		01/10			4
							CS-137	1.8 +-0.3 E-01		01/10			4
32294	LCK-2850 E 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.9 +-0.3 E 00	PPM *				3
							U-235	L.T. 2. E-01		01/10			4
							TH-234	L.T. 5. E-01		01/10			4
							PB-214	5.5 +-0.6 E-01		01/10			4
							BI-214	4.9 +-0.5 E-01		01/10			4
							AC-228	L.T. 1. E-01		01/10			4
							PB-212	5.3 +-0.5 E-01		01/10			4
							TL-208	1.7 +-0.2 E-01		01/10			4
							K-40	8.0 +-0.8 E 00		01/10			4
							CS-137	1.2 +-0.3 E-01		01/10			4
32295	LG-50 A 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.1 +-0.2 E 00	PPM *				3
							U-235	L.T. 2. E-01		01/14			4
							TH-234	L.T. 7. E-01		01/14			4
							PB-214	4.1 +-0.7 E-01		01/14			4
							BI-214	3.8 +-0.6 E-01		01/14			4
							AC-228	4.0 +-1.0 E-01		01/14			4
							PB-212	3.0 +-0.4 E-01		01/14			4
							TL-208	1.1 +-0.3 E-01		01/14			4
							K-40	7.4 +-0.7 E 00		01/14			4
							CS-137	L.T. 3. E-02		01/14			4

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32296	LG-50 A 6-12		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.3 +-0.2 E 00 PPM	*				3
							U-235	L.T. 2. E-01		01/10			4
							TH-234	L.T. 6. E-01		01/10			4
							PB-214	3.9 +-0.6 E-01		01/10			4
							BI-214	4.3 +-0.6 E-01		01/10			4
							AC-228	3.9 +-1.0 E-01		01/10			4
							PB-212	3.2 +-0.3 E-01		01/10			4
							TL-208	9.4 +-2.5 E-02		01/10			4
							K-40	1.1 +-0.1 E 01		01/10			4
							CS-137	L.T. 3. E-02		01/10			4
32297	LG-50 B 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.2 +-0.2 E 00 PPM	*				3
							U-235	L.T. 2. E-01		01/10			4
							TH-234	L.T. 6. E-01		01/10			4
							PB-214	4.2 +-0.6 E-01		01/10			4
							BI-214	3.5 +-0.6 E-01		01/10			4
							AC-228	L.T. 2. E-01		01/10			4
							PB-212	3.5 +-0.4 E-01		01/10			4
							TL-208	1.4 +-0.3 E-01		01/10			4
							K-40	7.7 +-0.8 E 00		01/10			4
							CS-137	L.T. 3. E-02		01/10			4
32298	LG-50 C 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.5 +-0.2 E 00 PPM	*				3
							U-235	L.T. 1. E-01		01/14			4
							TH-234	L.T. 5. E-01		01/14			4
							PB-214	4.6 +-0.5 E-01		01/14			4
							BI-214	3.9 +-0.5 E-01		01/14			4
							AC-228	3.9 +-0.7 E-01		01/14			4
							PB-212	3.2 +-0.3 E-01		01/14			4

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TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	START TIME	STOP DATE	STOP TIME	NUCLIDE	ACTIVITY (PCI/GM DRY)	NUCL-UNIT-% U/M *	MID-COUNT TIME DATE	MID-COUNT TIME TIME	VOLUME - UNITS ASH-WGHT-% *	LAB.
32298	LG-50 C 0-6		12/03				TL-208	1.2 +-0.2 E-01		01/14			4
							K-40	8.0 +-0.8 E 00		01/14			4
							CS-137	L.T. 3. E-02		01/14			4
32299	LG-50 D 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.3 +-0.2 E 00	PPM *				3
							U-235	L.T. 2. E-01		01/10			4
							TH-234	L.T. 5. E-01		01/10			4
							PB-214	4.2 +-0.5 E-01		01/10			4
							BI-214	4.2 +-0.5 E-01		01/10			4
							AC-228	3.1 +-0.7 E-01		01/10			4
							PB-212	4.2 +-0.4 E-01		01/10			4
							TL-208	1.5 +-0.2 E-01		01/10			4
							K-40	8.6 +-0.9 E 00		01/10			4
							CS-137	L.T. 3. E-02		01/10			4
32300	LG-50 E 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.3 +-0.2 E 00	PPM *				3
							U-235	L.T. 2. E-01		01/10			4
							TH-234	L.T. 7. E-01		01/10			4
							PB-214	4.5 +-0.6 E-01		01/10			4
							BI-214	5.2 +-0.7 E-01		01/10			4
							AC-228	3.4 +-0.9 E-01		01/10			4
							PB-212	3.8 +-0.4 E-01		01/10			4
							TL-208	1.5 +-0.3 E-01		01/10			4
							K-40	8.4 +-0.8 E 00		01/10			4
							CS-137	L.T. 4. E-02		01/10			4

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TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	START TIME	STOP DATE	STOP TIME	NUCLIDE	ACTIVITY (PCI/GM DRY)	NUCL-UNIT-% U/M *	MID-COUNT TIME DATE	MID-COUNT TIME TIME	VOLUME - UNITS ASH-WGHT-% *	LAB.
32301	LG-150 A 0-6		12/03				PREP	DISSO LVED	*				3
							TOTAL-U	1.0 +-0.2 E 00	PPM *				3
							U-235	L.T. 2. E-01		01/10			4
							TH-234	L.T. 5. E-01		01/10			4
							PB-214	4.0 +-0.5 E-01		01/10			4
							BI-214	3.6 +-0.5 E-01		01/10			4
							AC-228	2.5 +-0.8 E-01		01/10			4
							PB-212	2.7 +-0.3 E-01		01/10			4
							TL-208	1.0 +-0.2 E-01		01/10			4
							K-40	6.3 +-0.6 E 00		01/10			4
							CS-137	L.T. 3. E-02		01/10			4
32302	LG-150 A 6-12		12/03				PREP	DISSO LVED					3
							TOTAL-U	8.3 +-1.2 E-01	PPM *				3
							U-235	L.T. 1. E-01		01/10			4
							TH-234	6.8 +-3.4 E-01		01/10			4
							PB-214	4.0 +-0.5 E-01		01/10			4
							BI-214	3.5 +-0.4 E-01		01/10			4
							AC-228	2.6 +-0.7 E-01		01/10			4
							PB-212	3.3 +-0.3 E-01		01/10			4
							TL-208	1.0 +-0.2 E-01		01/10			4
							K-40	6.6 +-0.7 E 00		01/10			4
							CS-137	L.T. 2. E-02		01/10			4
32303	LG-150 B 0-6		12/03				PREP	DISSO LVED					3
							TOTAL-U	1.1 +-0.2 E 00	PPM *				3
							U-235	L.T. 2. E-01		01/10			4
							TH-234	L.T. 5. E-01		01/10			4
							PB-214	5.4 +-0.5 E-01		01/10			4
							BI-214	4.4 +-0.5 E-01		01/10			4
							AC-228	3.5 +-0.7 E-01		01/10			4
							PB-212	3.1 +-0.3 E-01		01/10			4

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32303	LG-150 B 0-6		12/03				TL-208	1.1 +-0.2 E-01		01/10			4
							K-40	7.0 +-0.7 E 00		01/10			4
							CS-137	L.T. 2. E-02		01/10			4
32304	LG-150 C 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.0 +-0.2 E 00 PPM	*				3
							U-235	L.T. 2. E-01		01/13			4
							TH-234	L.T. 6. E-01		01/13			4
							PB-214	4.4 +-0.7 E-01		01/13			4
							BI-214	4.2 +-0.6 E-01		01/13			4
							AC-228	4.0 +-1.1 E-01		01/13			4
							PB-212	2.5 +-0.4 E-01		01/13			4
							TL-208	1.3 +-0.3 E-01		01/13			4
							K-40	7.7 +-0.8 E 00		01/13			4
							CS-137	7.3 +-2.9 E-02		01/13			4
32305	LG-150 D 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.3 +-0.2 E 00 PPM	*				3
							U-235	L.T. 2. E-01		01/13			4
							TH-234	L.T. 5. E-01		01/13			4
							PB-214	4.3 +-0.5 E-01		01/13			4
							BI-214	3.8 +-0.5 E-01		01/13			4
							AC-228	2.9 +-0.8 E-01		01/13			4
							PB-212	2.9 +-0.3 E-01		01/13			4
							TL-208	9.3 +-2.2 E-02		01/13			4
							K-40	6.9 +-0.7 E 00		01/13			4
							CS-137	L.T. 3. E-02		01/13			4

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32306	LG-150 E 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.3 +-0.2 E 00	PPM *				3
							U-235	L.T. 2. E-01		01/13			4
							TH-234	L.T. 6. E-01		01/13			4
							PB-214	5.5 +-0.6 E-01		01/13			4
							BI-214	5.2 +-0.6 E-01		01/13			4
							AC-228	2.8 +-0.9 E-01		01/13			4
							PB-212	3.4 +-0.3 E-01		01/13			4
							TL-208	1.2 +-0.3 E-01		01/13			4
							K-40	7.6 +-0.8 E 00		01/13			4
							CS-137	L.T. 3. E-02		01/13			4
32307	LG-550 A 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.2 +-0.2 E 00	PPM *				3
							U-235	L.T. 2. E-01		01/13			4
							TH-234	L.T. 5. E-01		01/13			4
							PB-214	4.6 +-0.6 E-01		01/13			4
							BI-214	4.6 +-0.6 E-01		01/13			4
							AC-228	2.5 +-0.7 E-01		01/13			4
							PB-212	2.8 +-0.3 E-01		01/13			4
							TL-208	1.0 +-0.2 E-01		01/13			4
							K-40	6.5 +-0.7 E 00		01/13			4
							CS-137	L.T. 3. E-02		01/13			4
32308	LG-550 A 6-12		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.2 +-0.2 E 00	PPM *				3
							U-235	L.T. 1. E-01		01/13			4
							TH-234	L.T. 4. E-01		01/13			4
							PB-214	4.0 +-0.4 E-01		01/13			4
							BI-214	4.0 +-0.4 E-01		01/13			4
							AC-228	3.4 +-0.6 E-01		01/13			4
							PB-212	4.1 +-0.4 E-01		01/13			4

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32308	LG-550 A 6-12		12/03				TL-208	1.0 +-0.2 E-01	*	01/13			4
							K-40	7.8 +-0.8 E 00		01/13			4
							CS-137	3.9 +-1.6 E-02		01/13			4
32309	LG-550 B 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.1 +-0.2 E 00 PPM	*				3
							U-235	L.T. 2. E-01		01/13			4
							TH-234	L.T. 6. E-01		01/13			4
							PB-214	4.8 +-0.6 E-01		01/13			4
							BI-214	3.7 +-0.5 E-01		01/13			4
							AC-228	2.5 +-0.9 E-01		01/13			4
							PB-212	2.7 +-0.3 E-01		01/13			4
							TL-208	9.3 +-2.5 E-02		01/13			4
							K-40	6.7 +-0.7 E 00		01/13			4
							CS-137	L.T. 3. E-02		01/13			4
32310	LG-550 C 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.5 +-0.2 E 00 PPM	*				3
							U-235	L.T. 3. E-01		01/13			4
							TH-234	L.T. 1. E 00		01/13			4
							PB-214	5.1 +-0.8 E-01		01/13			4
							BI-214	L.T. 1. E-01		01/13			4
							AC-228	L.T. 2. E-01		01/13			4
							PB-212	2.8 +-0.4 E-01		01/13			4
							TL-208	1.4 +-0.3 E-01		01/13			4
							K-40	7.0 +-0.7 E 00		01/13			4
							CS-137	9.6 +-2.9 E-02		01/13			4

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32311	LG-550 D 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.1 +-0.2 E 00	PPM *				3
							U-235	L.T. 2. E-01		01/13			4
							TH-234	1.1 +-0.3 E 00		01/13			4
							PB-214	3.6 +-0.5 E-01		01/13			4
							BI-214	3.5 +-0.5 E-01		01/13			4
							AC-228	2.7 +-0.7 E-01		01/13			4
							PB-212	2.6 +-0.3 E-01		01/13			4
							TL-208	1.1 +-0.2 E-01		01/13			4
							K-40	7.6 +-0.8 E 00		01/13			4
							CS-137	3.9 +-0.4 E-01		01/13			4
32312	LG-550 E 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.3 +-0.2 E 00	PPM *				3
							U-235	L.T. 2. E-01		01/13			4
							TH-234	L.T. 6. E-01		01/13			4
							PB-214	4.8 +-0.5 E-01		01/13			4
							BI-214	4.7 +-0.5 E-01		01/13			4
							AC-228	2.8 +-0.7 E-01		01/13			4
							PB-212	3.9 +-0.4 E-01		01/13			4
							TL-208	1.1 +-0.2 E-01		01/13			4
							K-40	7.6 +-0.8 E 00		01/13			4
							CS-137	1.1 +-0.2 E-01		01/13			4
32320	POND A NO.1 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	3.0 +-0.5 E 00	PPM *				3
							U-235	L.T. 1. E-01		01/13			4
							TH-234	1.7 +-0.4 E 00		01/13			4
							PB-214	6.4 +-0.6 E-01		01/13			4
							BI-214	5.6 +-0.6 E-01		01/13			4
							AC-228	3.8 +-0.7 E-01		01/13			4
							PB-212	3.5 +-0.4 E-01		01/13			4

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32320	POND A NO.1 0-6		12/03				TL-208	1.3 +-0.2 E-01		01/13			4
							K-40	5.5 +-0.6 E 00		01/13			4
							CS-137	L.T. 2. E-02		01/13			4
32321	POND A NO.2 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	3.9 +-0.6 E 00 PPM	*				3
							U-235	L.T. 2. E-01		01/13			4
							TH-234	9.6 +-3.5 E-01		01/13			4
							PB-214	3.6 +-0.5 E-01		01/13			4
							BI-214	4.1 +-0.5 E-01		01/13			4
							AC-228	3.0 +-0.7 E-01		01/13			4
							PB-212	3.7 +-0.4 E-01		01/13			4
							TL-208	1.2 +-0.2 E-01		01/13			4
							K-40	5.7 +-0.6 E 00		01/13			4
							CS-137	L.T. 3. E-02		01/13			4
32322	POND B NO.1 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.0 +-0.2 E 00 PPM	*				3
							U-235	L.T. 2. E-01		01/13			4
							TH-234	6.6 +-3.4 E-01		01/13			4
							PB-214	6.3 +-0.6 E-01		01/13			4
							BI-214	5.7 +-0.6 E-01		01/13			4
							AC-228	2.2 +-0.8 E-01		01/13			4
							PB-212	2.8 +-0.3 E-01		01/13			4
							TL-208	1.3 +-0.2 E-01		01/13			4
							K-40	5.2 +-0.5 E 00		01/13			4
							CS-137	L.T. 3. E-02		01/13			4

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32323	POND B NO.2 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	7.0 +-1.1 E 00	PPM *				3
							U-235	L.T. 5. E-02		01/14			4
							TH-234	3.6 +-0.5 E 00		01/14			4
							PB-214	1.2 +-0.1 E 00		01/14			4
							BI-214	1.1 +-0.1 E 00		01/14			4
							AC-228	1.1 +-0.1 E 00		01/14			4
							PB-212	1.1 +-0.1 E 00		01/14			4
							TL-208	3.6 +-0.4 E-01		01/14			4
							K-40	1.5 +-0.2 E 01		01/14			4
							CS-137	L.T. 5. E-02		01/14			4
32324	POND C NO.1 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	1.3 +-0.2 E 00	PPM *				3
							U-235	L.T. 2. E-01		01/14			4
							TH-234	L.T. 5. E-01		01/14			4
							PB-214	6.1 +-0.6 E-01		01/14			4
							BI-214	5.4 +-0.6 E-01		01/14			4
							AC-228	3.1 +-0.8 E-01		01/14			4
							PB-212	2.1 +-0.4 E-01		01/14			4
							TL-208	1.0 +-0.3 E-01		01/14			4
							K-40	5.3 +-0.5 E 00		01/14			4
							CS-137	L.T. 3. E-02		01/14			4
32325	POND C NO.2 0-6		12/03				PREP	DISSOLVED					3
							TOTAL-U	3.1 +-0.5 E 00	PPM *				3
							U-235	L.T. 2. E-01		01/14			4
							TH-234	1.0 +-0.5 E 00		01/14			4
							PB-214	9.3 +-0.9 E-01		01/14			4
							BI-214	9.6 +-1.0 E-01		01/14			4
							AC-228	9.2 +-1.2 E-01		01/14			4
							PB-212	8.9 +-0.9 E-01		01/14			4

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MR RICARDO DE ANDA
DE ANDA LAW FIRM
PLAZA DE SAN AGUSTIN
212 FLORES AVENUE
LAREDO TX 78040

S O I L

TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	START TIME	STOP DATE	STOP TIME	NUCLIDE	ACTIVITY (PCI/GM DRY)	NUCL-UNIT-% U/M *	MID-COUNT TIME DATE	MID-COUNT TIME TIME	VOLUME - UNITS ASH-WGHT-% *	LAB.
32325	POND C NO.2 0-6		12/03				TL-208	3.2 +-0.3 E-01		01/14			4
							K-40	1.3 +-0.1 E 01		01/14			4
							CS-137	L.T. 4. E-02		01/14			4

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

REPORT OF ANALYSIS

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MR RICARDO DE ANDA
DE ANDA LAW FIRM
PLAZA DE SAN AGUSTIN
212 FLORES AVENUE
LAREDO TX 78040

VEGETATION/TERRESTRIAL

TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	START TIME	STOP DATE	STOP TIME	NUCLIDE	ACTIVITY (PCI/GM WET)	NUCL-UNIT-% U/M *	MID-COUNT TIME DATE	MID-COUNT TIME TIME	VOLUME - UNITS ASH-WGHT-% *	LAB.
32313	VEG SPG OUTPD NO SIDE		12/03				BE-7	1.97+-0.47E 00		12/06			4
							K-40	2.35+-0.50E 00		12/06			4
							MN-54	L.T. 6. E-02		12/06			4
							CO-58	L.T. 6. E-02		12/06			4
							FE-59	L.T. 1. E-01		12/06			4
							CO-60	L.T. 6. E-02		12/06			4
							ZN-65	L.T. 1. E-01		12/06			4
							ZR-95	L.T. 6. E-02		12/06			4
							RU-103	L.T. 7. E-02		12/06			4
							RU-106	L.T. 6. E-01		12/06			4
							I-131	L.T. 9. E-02		12/06			4
							CS-134	L.T. 6. E-02		12/06			4
							CS-137	L.T. 7. E-02		12/06			4
							BA-140	L.T. 7. E-02		12/06			4
							CE-141	L.T. 9. E-02		12/06			4
							CE-144	L.T. 4. E-01		12/06			4
							RA-226	L.T. 1. E 00		12/06			4
							TH-228	L.T. 1. E-01		12/06			4
							TOTAL-U	L.T. 1. E 00		12/06			4
32314	VEG SPG OUTPD SO SIDE		12/03				BE-7	2.38+-0.85E 00		12/06			4
							K-40	7.01+-1.09E 00		12/06			4
							MN-54	L.T. 1. E-01		12/06			4
							CO-58	L.T. 1. E-01		12/06			4
							FE-59	L.T. 2. E-01		12/06			4
							CO-60	L.T. 1. E-01		12/06			4
							ZN-65	L.T. 3. E-01		12/06			4
							ZR-95	L.T. 1. E-01		12/06			4
							RU-103	L.T. 1. E-01		12/06			4
							RU-106	L.T. 1. E 00		12/06			4
							I-131	L.T. 2. E-01		12/06			4
							CS-134	L.T. 1. E-01		12/06			4

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

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MR RICARDO DE ANDA
DE ANDA LAW FIRM
PLAZA DE SAN AGUSTIN
212 FLORES AVENUE
LAREDO TX 78040

VEGETATION/TERRESTRIAL

TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	START TIME	STOP DATE	STOP TIME	NUCLIDE	ACTIVITY (PCI/GM WET)	NUCL-UNIT-% U/M *	MID-COUNT TIME DATE	MID-COUNT TIME TIME	VOLUME - UNITS ASH-WGHT-% *	LAB.
32314	VEG SPG OUTPD SO SIDE		12/03				CS-137	L.T. 1. E-01		12/06			4
							BA-140	L.T. 1. E-01		12/06			4
							CE-141	L.T. 2. E-01		12/06			4
							CE-144	L.T. 7. E-01		12/06			4
							RA-226	L.T. 2. E 00		12/06			4
							TH-228	L.T. 2. E-01		12/06			4
							TOTAL-U	L.T. 2. E 00		12/06			4
32315	VEG SPG OUTPD E SIDE		12/03				BE-7	1.89+-0.51E 00		12/06			4
							K-40	2.26+-0.55E 00		12/06			4
							MN-54	L.T. 7. E-02		12/06			4
							CO-58	L.T. 6. E-02		12/06			4
							FE-59	L.T. 1. E-01		12/06			4
							CO-60	L.T. 7. E-02		12/06			4
							ZN-65	L.T. 1. E-01		12/06			4
							ZR-95	L.T. 7. E-02		12/06			4
							RU-103	L.T. 7. E-02		12/06			4
							RU-106	L.T. 6. E-01		12/06			4
							I-131	L.T. 9. E-02		12/06			4
							CS-134	L.T. 7. E-02		12/06			4
							CS-137	L.T. 7. E-02		12/06			4
							BA-140	L.T. 8. E-02		12/06			4
							CE-141	L.T. 9. E-02		12/06			4
							CE-144	L.T. 4. E-01		12/06			4
							RA-226	L.T. 1. E 00		12/06			4
							TH-228	L.T. 1. E-01		12/06			4
							TOTAL-U	L.T. 1. E 00		12/06			4

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

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MR RICARDO DE ANDA
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VEGETATION/TERRESTRIAL

TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	START TIME	STOP DATE	STOP TIME	NUCLIDE	ACTIVITY (PCI/GM WET)	NUCL-UNIT-% U/M *	MID-COUNT TIME DATE	MID-COUNT TIME TIME	VOLUME - UNITS ASH-WGHT-% *	LAB.
32316	VEG SPG OUTPD W SIDE		12/03				BE-7	3.33+-0.52E 00		12/06			4
							K-40	3.36+-0.59E 00		12/06			4
							MN-54	L.T. 6. E-02		12/06			4
							CO-58	L.T. 6. E-02		12/06			4
							FE-59	L.T. 1. E-01		12/06			4
							CO-60	L.T. 7. E-02		12/06			4
							ZN-65	L.T. 1. E-01		12/06			4
							ZR-95	L.T. 6. E-02		12/06			4
							RU-103	L.T. 7. E-02		12/06			4
							RU-106	L.T. 6. E-01		12/06			4
							I-131	L.T. 1. E-01		12/06			4
							CS-134	L.T. 7. E-02		12/06			4
							CS-137	L.T. 7. E-02		12/06			4
							BA-140	L.T. 8. E-02		12/06			4
							CE-141	L.T. 1. E-01		12/06			4
							CE-144	L.T. 5. E-01		12/06			4
							RA-226	L.T. 2. E 00		12/06			4
							TH-228	L.T. 1. E-01		12/06			4
							TOTAL-U	L.T. 1. E 00		12/06			4
32317	VEG SPG OUTPD LWR ARE		12/03				BE-7	4.13+-2.19E-01		12/06			4
							K-40	3.17+-0.32E 00		12/06			4
							MN-54	L.T. 3. E-02		12/06			4
							CO-58	L.T. 3. E-02		12/06			4
							FE-59	L.T. 6. E-02		12/06			4
							CO-60	L.T. 3. E-02		12/06			4
							ZN-65	L.T. 7. E-02		12/06			4
							ZR-95	L.T. 3. E-02		12/06			4
							RU-103	L.T. 3. E-02		12/06			4
							RU-106	L.T. 3. E-01		12/06			4
							I-131	L.T. 4. E-02		12/06			4
							CS-134	L.T. 3. E-02		12/06			4

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

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MR RICARDO DE ANDA
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VEGETATION/TERRESTRIAL

TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	START TIME	STOP DATE	STOP TIME	NUCLIDE	ACTIVITY (PCI/GM WET)	NUCL-UNIT-% U/M *	MID-COUNT TIME DATE	MID-COUNT TIME TIME	VOLUME - UNITS ASH-WGHT-% *	LAB.
32317	VEG SPG OUTPD LWR ARE		12/03				CS-137	L.T. 3. E-02		12/06			4
							BA-140	L.T. 4. E-02		12/06			4
							CE-141	L.T. 4. E-02		12/06			4
							CE-144	L.T. 2. E-01		12/06			4
							RA-226	L.T. 6. E-01		12/06			4
							TH-228	L.T. 5. E-02		12/06			4
							TOTAL-U	L.T. 5. E-01		12/06			4

TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

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MR RICARDO DE ANDA
DE ANDA LAW FIRM
PLAZA DE SAN AGUSTIN
212 FLORES AVENUE
LAREDO TX 78040

W A T E R

TELEDYNE SAMPLE NUMBER	CUSTOMER'S IDENTIFICATION	STA NUM	COLLECTION-DATE START DATE	START TIME	STOP DATE	STOP TIME	NUCLIDE	ACTIVITY (PCI/LITER)	NUCL-UNIT-% U/M *	MID-COUNT TIME DATE	MID-COUNT TIME TIME	VOLUME - UNITS ASH-WGHT-% *	LAB.
32318	WATER SPRING OUTPOND		12/03				RA-226	L.T. 3. E-01		01/02			2
							TOTAL U	7.0 +-1.1 E 00	UGM/LITER *				3
32319	WATER SPG NATRL POND		12/03				RA-226	9.4 +-2.8 E-01		01/02			2
							TOTAL U	5.4 +-0.8 E 00	UGM/LITER *				3

LAST PAGE OF REPORT

J. Guenther
APPROVED BY J. GUENTHER 01/21/97

SEND 1 COPIES TO DE205S MR RICARDO DE ANDA
SEND 1 COPIES TO DE205T MR MARVIN RESNIKOFF

2 - GAS LAB. 3 - RADIO CHEMISTRY LAB. 4 - GE(LI) GAMMA SPEC LAB. 5 - TRITIUM GAS/L.S. LAB. 6 - ALPHA SPEC LAB.

NEW MEXICO
ENVIRONMENTAL LAW CENTER

Mr. Michael T. Lesar
Chief, Rulemakings and Directives Branch
Mail Stop: TWB-05-B01M
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

March 4, 2010

RE: Attachment F to Southwest Research and Information Center's Comments on Nichols Ranch SEIS; Docket ID NRC-2008-0339

Dear Chief Lesar:

Per my email dated March 2, 2010, please find enclosed Exhibit F to Southwest Research and Information Center's Comments on the above supplemental environmental impact statement. Please do not hesitate to contact me if you have any concerns or need additional information.

Sincerely,

Eric Jantz
Staff Attorney
New Mexico Environmental Law Center
1405 Luisa Street, Ste. 5
Santa Fe, New Mexico 87505
(505) 989-9022
ejantz@nmelc.org

1-3-08

WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY
LAND QUALITY DIVISION

SETTLEMENT AGREEMENT

The Wyoming Department of Environmental Quality, Land Quality Division (DEQ) and Power Resources, Inc. (PRI) doing business as Cameco Resources enter into this Settlement Agreement to fully and finally resolve without litigation the violations alleged in Notice of Violation (NOV) Docket No. 4231-08, dated March 7, 2008, regarding Highland, Permit 603, and Smith Ranch, Permit 633, insitu uranium mines. The NOV alleges non-concurrent restoration at both mines. DEQ rules and the respective mine permits require concurrent restoration or, if concurrent restoration is not possible, earliest possible restoration consistent with the orderly and economic development of the property. The Highland and Smith Ranch mines are located in Converse County.

Wyoming Statute (W.S.) §35-11-901(a)(ii) authorizes the DEQ to attempt to eliminate the cause of the violations by settlement, in lieu of litigation. To that end, PRI and the DEQ stipulate and agree as follows:

1/24 The DEQ pursuant to W.S. §35-11-104, is a department in the executive branch of the state government of Wyoming and is located in Cheyenne, Wyoming. DEQ is the agency responsible for administering the Wyoming Environmental Quality Act and the DEQ rules and regulations.

2/24 PRI is the permit holder and operator of DEQ Permits 603 and 633 for uranium mining operations located in parts of Townships 35 and 36 North, Ranges 73 to 75 West in Converse County.

3/24 DEQ rules and the Highland and Smith Ranch mine permits require concurrent restoration or, if concurrent restoration is not possible, earliest possible restoration consistent with the orderly and economic development of the property. Failure to comply with this requirement is a violation of DEQ rules and the respective mine permits.

4/24 PRI shall cease land application activities on or before October 15, 2009, unless PRI demonstrates wastewater disposed of via land application has an average selenium level of 0.1 mg/L or less.

5/24 PRI will bond Highland and Smith Ranch for eighty million dollars ($80,000,000.00) within 45 days of the execution of this Settlement Agreement by increasing the bond for Highland, Permit 603, to $48,000,000.00 and increasing the bond for Smith Ranch, Permit 633, to $32,000,000.00.

6/24 PRI will submit Highland and Smith Ranch permit revisions for revised restoration plans including restoration schedules for the existing permit approved mine units by August 1, 2008. The revision will include discussion of extraction rates, number of pore volumes of groundwater sweep and reverse osmosis treatments, and a water balance demonstrating the volumes available to conduct restoration as well as the waste water capacity to support the disposal of these volumes.

7/24 PRI will submit by August 1, 2008, a capital improvement plan. The capital improvement plan will provide for a minimum of eight million dollars ($8,000,000.00) to be spent by December 31, 2010 to accelerate restoration and reclamation activities.

8/24 DEQ will review the Highland and Smith Ranch revised restoration plans, restoration schedules, and the capital improvement plan within 45 days of receipt and either approve the permit revisions for insertion into the respective permits or provide review comments to PRI.

9/24 In the event DEQ issues review comments on the Highland and Smith Ranch revised restoration plans, restoration schedules, or capital improvement plan, PRI will respond to the DEQ within 45 days of receipt of the review comments.

10/24 Both PRI and the DEQ commit to finalizing the Highland and Smith Ranch revised restoration plans, restoration schedules, and capital improvement plan by December 31, 2008. Upon approval, the restoration plans and restoration schedule will be inserted into the respective

Attachment
F

permits and the capital improvement plan will be filed with the Settlement Agreement. Upon approval, PRI also will recalculate the bond amount for Highland and Smith Ranch and submit this information to the DEQ for review no later than February 28, 2009.

11/24 PRI will accelerate restoration activities in accordance with the following schedule:

Commencement Date	Site Reference	Restoration Activity
August 1, 2008	Mine Unit C	Accelerate restoration by replacing the membranes on the existing reverse osmosis unit thereby increasing the restoration capacity of the unit by 70 gpm, which is anticipated to result in an increase in the annual average flow rate to approximately 390 gpm. PRI will maintain the pertinent flow rate data on site.
October 1, 2008	Mine Unit 1	Accelerate restoration by increasing reverse osmosis treatment capacity by 200 gpm, which is anticipated to result in an increase in the annual average flow rate to approximately 390 gpm. PRI will maintain the pertinent flow rate data on site.

12/24 Subject to PRI fully complying with this Settlement Agreement, Permit 603 and Permit 633, and other applicable laws and regulations, PRI may maintain uranium mining activities at an annual production level equal to PRI's average annual production of U_3O_8 for the years 2006 and 2007 (not more than 2,000,000 pounds annually), and PRI may file applications for permit revisions to bring Mine Units 9, 10, 11, 12, K, and/or J-Extension into production as necessary to maintain this level of production. DEQ will not authorize PRI to increase U_3O_8 production at Highland and Smith Ranch mines over the average annual production for 2006 and 2007 before March 1, 2009.

13/24 PRI agrees to pay a penalty of nine hundred thousand dollars ($900,000) as stipulated settlement as partial resolution to this matter in lieu of litigation under W.S. § 35-11-901(a)(ii). PRI will pay five hundred thousand dollars ($500,000) directly to the DEQ upon execution of the signed Settlement Agreement. Four hundred thousand dollars ($400,000) will be suspended if PRI satisfies the terms of the Settlement Agreement. In the event PRI does not satisfy the terms of the Settlement Agreement, four hundred thousand dollars ($400,000) will be due within thirty (30) days notice by the DEQ. Payment to the DEQ shall be by check and made payable to the Wyoming Department of Environmental Quality/Land Quality Division, and shall be sent to: Donald R. McKenzie, Administrator, WDEQ, LQD, Herschler Building, 3 Fl-West, 122 West 25th Street, Cheyenne, WY 82002.

14/24 Upon execution of the signed Settlement Agreement, PRI also will pay five hundred thousand dollars ($500,000.00) to the DEQ to fund future, unspecified Supplemental Environmental Projects (SEP's). SEP's shall be determined by the DEQ and shall address groundwater restoration, protection, monitoring, or pollution reduction issues related to in situ uranium mining. Payment of the SEP funds shall be made by check and made payable to the Wyoming Department of Environmental Quality.

15/24 PRI's full compliance with this signed Settlement Agreement including payment by PRI as specified above shall constitute full satisfaction for and resolution of all claims by the DEQ against PRI based on the violations alleged in NOV Docket No. 4231-08. Contingent upon PRI compliance with the terms of this Settlement Agreement, the DEQ will refrain from taking further enforcement action against PRI for these particular violations cited in this Settlement Agreement. By this Settlement Agreement, the parties intend to resolve with prejudice all allegations that were asserted in NOV Docket No. 4231-08.

16/24 PRI waives any statute of limitations which may apply to an enforcement action by the DEQ involving the specific matters described here in, in the event that PRI fails to fulfill its obligations under this Settlement Agreement.

17/24 Neither party shall be liable for failure to perform under this Agreement if such failure to perform arises out of causes beyond the control and without the fault or negligence of the nonperforming party. Such causes may include, but are not limited to, acts of God or the public enemy, fires, floods, epidemics, quarantine restrictions, freight embargoes, and unusually severe weather. This provision shall become effective only if the party failing to perform promptly notifies the other party of the extent and nature of the problem, limits delay in performance to that required by the event, and takes all reasonable steps to minimize delays.

18/24 Nothing in this agreement precludes DEQ from taking additional enforcement action, including the issuance of a NOV, and/or pursuing additional penalties, should PRI violate Wyoming Statutes or applicable rules and regulations in the future.

19/24 This Settlement Agreement shall be admissible by either party without objection by the other party in any subsequent action between these parties.

20/24 Not withstanding any other language in this Settlement Agreement, the State of Wyoming and the DEQ do not waive sovereign immunity by entering into this Settlement Agreement with PRI and specifically retain all immunity and all defenses available as sovereigns under state and federal law.

21/24 Each party is responsible for its own costs, including attorney fees through the signing of this Settlement Agreement.

22/24 This Settlement Agreement is binding upon PRI successors and assigns, and upon the DEQ.

23/24 The persons signing this Settlement Agreement certify that they are duly authorized to bind their respective parties to this Settlement Agreement.

24/24 This Settlement Agreement shall become binding when signed by all parties.

FOR POWER RESOURCES, INC.:

Signed: Stephen P. Collings Date: July 8, 2008

Title: President

FOR THE WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY:

John V. Corra, Director, DEQ — Date: 7/7/08

Donald R. McKenzie, Administrator, LQD — Date: 07-07-08

xc: Becky Brosius, NOV Files (603 & 633), Lowell Spackman, LQD, Doug Mandeville, NRC

3872076_5.DOC

Department of Environmental Quality

To protect, conserve and enhance the quality of Wyoming's environment for the benefit of current and future generations.

Dave Freudenthal, Governor

John Corra, Director

March 10, 2008

CERTIFIED MAIL, RETURN RECEIPT REQUESTED #7005 1820 0005 1478 8828

Mr. John McCarthy
Power Resources, Inc.
P.O. Box 1210
Glenrock WY 82637

RE: Insitu Uranium Permits 603 and 633, Notice of Violation, Docket No. 4231-08

Dear Mr. McCarthy:

Enclosed you will find a Notice of Violation issued under the provisions of W.S.§ 35-11-415(a) and (b)(ii). The Notice of Violation is based on the investigation conducted Mr. Mark Moxley during the fall of 2007. The investigation found that PRI failed to conduct concurrent reclamation which is a violation of Chapter 3, Section 2(k)(i)(D), and that PRI failed to follow the approved permits.

The Wyoming Department of Environmental Quality/Land Quality Division (LQD) is attempting to resolve this issue without further enforcement action, and requires that you contact Mr. Donald R. McKenzie, LQD Administrator at 307-777-7046 **within fifteen (15) days of receipt of this letter** to schedule a meeting to resolve this enforcement action. Should resolution of this enforcement action be reached as a result of this meeting, a Settlement Agreement including a penalty assessment will be signed by both parties.

Respectfully,

John V. Corra
Director
Department of Environmental Quality

Donald R. McKenzie
Administrator
Land Quality Division

Enclosures: Notice of Violation
Investigation Report

cc: Lowell Spackman, District I w/attachments
Mark Moxley, District II w/attachments
Docket # 4231-08 w/attachments
Doug Mandeville, NRC w/attachments

DEPARTMENT OF ENVIRONMENTAL QUALITY
STATE OF WYOMING

NOTICE OF VIOLATION

IN THE MATTER OF THE NOTICE OF VIOLATION ISSUED TO
POWER RESOURCES, INC. **DOCKET NO. 4231-08**
P.O. BOX 1219
GLENROCK, WY 82637
Re: Insitu Uranium Operation, Permit #603
Re: Insitu Uranium Operation, Permit #633

NOTICE

NOTICE IS HEREBY GIVEN THAT:

1. Notice of Violation is being sent to you pursuant to W.S. §35-11-701(c) which requires that a written notice shall be issued in the case of failure to correct or remedy an alleged violation specifying the provision of the act, rule, regulation, standard, permit, license, or variance alleged to be violated.

2. As a result of Land Quality Division (LQD) concerns over the slow pace of groundwater restoration of wellfields at Power Resources, Inc. Permits 603 and 633 Insitu Uranium Mine, an investigation was conducted of the mine and reclamation plans in the approved permits, plus information provided in annual reports. This investigation was conducted by LQD staff during October and November of 2007. In addition to the violations cited below, LQD identified serious deficiencies with both permits. The plans contained in the permit documents are dated and incomplete in numerous ways: spill detection, reporting, and follow-up protocols are not defined in the permit; groundwater restoration procedures, necessary facilities, and time schedules for restoration must be thoroughly described; waste disposal facilities and processes must be described for all waste streams; all critical process installations need thorough construction details and specifications; and topsoil protection procedures are not adequately defined. As a consequence of the inadequacies of the permits, both operations are seriously under-bonded.

3. The investigation found that PRI failed to conduct concurrent reclamation which is a violation of Chapter 3, Section 2(k)(i)(D) requiring concurrent reclamation; and that PRI failed to follow the approved permits, which is a violation of W.S. §35-11-415(a). The following lists the specific violations:

   Permit 603

   a. Wellfield C was in production for approximately ten years. The approved Mine Plan states, *"Once a wellfield is installed it takes approximately one to three years to recover the leachable uranium from a production area."* Extending the production time period has become a routine practice and is not in compliance with the approved permit or the requirement for concurrent reclamation.

   b. In addition to the production phase, Wellfield C has now been in restoration for ten years. The 2007 Annual Report states that the ground water quality is similar to *"end of mining"* wellfield conditions. The permit states that restoration and stability are estimated to take approximately five years. This restoration delay is not in compliance with the approved permit or the requirement for concurrent reclamation.

   c. Wellfield E has removed 100% of the leachable reserves, and in recent years wellfield production has slowed to maintenance levels. This rate of production delays completion of mining and restoration of this wellfield

unit. This is not in compliance with the approved permit, and is a violation of Chapter 2, Section 2(b)(ii) which requires coordination of the Mine and Reclamation Plans to facilitate orderly development and reclamation.

d. The timetable listing the schedule of mining-related activities in the permit (Figure A, page OP-3A) and the timetable provided in the 2007 annual report both indicate that PRI is not in compliance with their restoration schedules for Wellfields C, D, and E. The schedule shows that Wellfield C should be decommissioning instead of in restoration, and that Wellfields D and E should be in restoration instead of production.

Permit 633

a. The permit indicates that "An updated schedule will be supplied with the annual report if the mining or restoration schedule varies from Table 3-1." The timetable commitments in the permit are not consistent with wellfield status. Therefore, the table in the annual report is the schedule that PRI is committed to for wellfield status. Based on this table, PRI is not in compliance with their restoration schedules for Wellfields 2, 3, and 4/4A. The annual report text indicates that Wellfield 2 will continue to be in production, while the annual report schedule referred to in the permit shows that it will be in restoration in 2008. Wellfields 3 and 4/4a should be in restoration instead of production.

b. The permit states that it generally takes "three years for uranium production, and three years for aquifer restoration." Actual times for wellfield production and restoration are, thus far, 2-3 times longer than permit commitments.

4. Wyoming Statute §35-11-901(a) provides that any person who violates any provision of the Environmental Quality Act or any rule, standard, permit, license or variance adopted hereunder is liable to a penalty of ten thousand dollars ($10,000.00) for each day of violation, which penalty may be recovered in a civil action brought by the Attorney General in the name of the People of the State of Wyoming.

NOTHING IN THIS NOTICE shall be interpreted to in any way, limit or contravene any other remedy available under the Environmental Quality Act, nor shall this Order be interpreted as being a condition precedent to any other enforcement action.

SIGNED this 7th day of March, 2008

John V. Corra
Director
Department of Environmental Quality

Donald R. McKenzie
Administrator
Land Quality Division

Please direct all inquiries regarding this Notice of Violation to Mr. Donald R. McKenzie, Administrator, Land Quality Division, Wyoming Department of Environmental Quality, 122 West 25th Street, Cheyenne, WY 82002. Telephone No. (307) 777-7046.

ec: Lowell Spackman, District I
Mark Moxley, District II
Docket # 4231-08
Doug Mandeville, NRC

45

MEMORANDUM

TO: John V. Corra, Director, Wyoming Department of Environmental Quality

THROUGH: Don McKenzie, Administrator, Land Quality Division

FROM: Steve Ingle

DATE: December 13, 2007

for #4231-08

SUBJECT: Notice of Violation, Docket No. 4197-07, Permit #603, Power Resources, Inc. (PRI), Support Documentation

I have divided this memo into five sections. The first section lists the regulatory requirements for concurrent restoration, the second section details the permit commitments and timelines in the permit. The third section discusses Wellfield C, which has been in restoration for approximately ten years. The fourth section discusses Wellfields E and F, where it appears completion of mining and initiating restoration has been delayed by PRI. The final section presents several possible reasons for why restoration may have been delayed.

Regulatory Requirements

Below is a list of regulations that require PRI to restore affected groundwater in a timely manner:

Chapter 2, Section 2(b)(ii) requires a time schedule for each reclamation step that coordinates the operators reclamation plan with the mining plan to facilitate reclamation at the earliest possible time.

Chapter 3, Section 2(k)(D) requires the company to establish reclamation concurrently with mining operations, whenever possible.

Chapter 11, Section 5(a)(i)(D) requires the capacity of the water/waste water treatment systems and correlation of the capacity with the mining and restoration schedules.

Permit Requirements

Permit #603 contains language that is intended to meet the regulations cited, above. This language is found on Page OP-4 of the Mine Plan and Page RP-7B of the reclamation plan. These pages state:

1. The estimated wellfield life and times needed for restoration are stated on Page OP-4 in Permit #603. The permit states:

- Once a wellfield is installed it takes approximately one to three years to recover the leachable uranium from a production area.
- Groundwater restoration activities are started once a wellfield is depleted.
- Restoration and stability is estimated to take approximately five years.

2. Page RP-7B states that ground water sweep will be used for approximately three to four pore volumes and an additional two to three pore volumes will be withdrawn and treated with reverse osmosis.

Wellfield C

Restoration began in Wellfield C in 1997 with groundwater sweep at a rate of 15-20 gpm for the first year. During the past ten years of restoration, the peak groundwater sweep rate was 63 gallons per minute (gpm) in 2003. This rate is approximately 0.278 Acre Feet/day. One pore volume in the C Wellfield is 236.9 AF of water. In order to remove one pore volume at a rate of 63 gpm, it would take approximately 2.3 years of continuous operation. Table 1 shows the historic groundwater sweep rates and the time needed to remove one pore volume if the sweep was continuous. To treat three pore volumes as stated in the permit would take approximately 6.9 years for the groundwater sweep phase of restoration. Reverse Osmosis (RO) was initiated during 2006 at a rate of 180 gpm and increased to 321 gpm in 2007. To date 2.25 pore volumes of RO have been completed. The 2007 Annual Report states that the water quality remains at pre-treatment values. Table 3-2 in the 2007 Annual Report does show an improvement in water quality, especially after the RO units began operating.

The decarbonation unit (which recirculates groundwater after removal of carbon dioxide and bicarbonate) has processed a total of 5,755 AF (24.3 pore volumes) of groundwater since restoration began. Testing of the decarbonation unit showed that the unit is up to 90% efficient. The 24.3 pore volumes should have removed all the carbon dioxide prior to this time.

The restoration bond is for one pore volume of groundwater sweep and five pore volumes of RO. If three pore volumes of groundwater sweep and three pore volumes of RO are necessary, the bond amount for groundwater treatment is adequate to cover restoration of the wellfield, because the RO costs exceed the groundwater sweep costs.

Other wellfields

Other wellfields, specifically the E and F wellfields have had between 90% and 100% of the leachable uranium removed (Figure 2 and Figure 3). The E-wellfield has had over 99% of the leachable uranium removed for approximately 5 years and 100% for 2 years and the F-wellfield has had over 90% of the leachable uranium removed for over 4 years (Table 2). The amount of uranium removed per year from these wellfields over these time periods has been less than 1% per year. Essentially, all that's been happening at these wellfields is maintaining a bleed, similar to Interim Mine Stabilization. It is my opinion that these wellfields have not been completely mined out, because PRI does not have sufficient wastewater disposal capacity, to begin restoration of these wellfields and

maintain current production rates. To a certain extent, groundwater sweep in these wellfields may hamper mining activities in adjacent operating fields, however pattern groups within the wellfield can begin groundwater sweep operations or certainly decarbonation.

The E-Wellfield is clearly a violation of the concurrent reclamation requirements in Chapter 3, Section 2(k). The wellfield has had 100% of the leachable uranium recovered for the past two years and less than 99% leachable uranium removed, for the five previous years.

Potential factors affecting the rate of restoration

There are several factors that may potentially slow the rate of restoration. The first factor is insufficient wastewater disposal facilities. PRI is maintaining production in several wellfields at their Highland and Smith Ranch properties and each wellfield produces more water than it injects, this bleed stream helps maintain a cone of depression into the wellfield to prevent excursions. The bleed stream fluid needs to be disposed of as wastewater. Chapter 11, Section 5(a)(i)(D) requires PRI to have sufficient wastewater treatment facilities to meet mining and restoration schedules.

Wellfield C, in part, adjoins Wellfield D and higher rates of groundwater sweep in Wellfield C may draw mining fluids into the field from Wellfield D. The permit allows PRI to establish a line of injection wells, between Wellfield D and Wellfield C to create a hydraulic barrier between the wellfields. A hydraulic barrier would allow Wellfield C to be restored with minimal effects to Wellfield D.

Hydrologic factors such as permeability and available water levels above production unit can also influence the maximum groundwater sweep rate. If the pumping rate is too high, the aquifer can be temporarily dewatered. Closely monitoring the water level changes can determine the maximum allowable groundwater sweep rate.

TABLE 1

Year	Sweep Rate/gpm	Volume AF	Cum Vol AF	AF/day	AF/year	Years/p.v.
2007	46	74	551	0.2	73	3.245205
2006	36	54	477	0.16	58.4	4.056507
2005	53	80	423	0.23	83.95	2.821918
2004	59	93	343	0.26	94.9	2.496312
2003	63	61	250	0.28	102.2	2.318004
2002	50	59.6	189.2	0.22	80.3	2.950187
2001	23	36.3	129.6	0.1	36.5	6.490411
2000	23	41.2	87.4	0.1	36.5	6.490411
1999	15-20	23.8	63.6	0.09	32.85	7.211568

AF = acre feet
p.v. = pore volume, one pore volume for Wellfield C is 236.9 acre-feet of water

FIGURE 1, E Wellfield

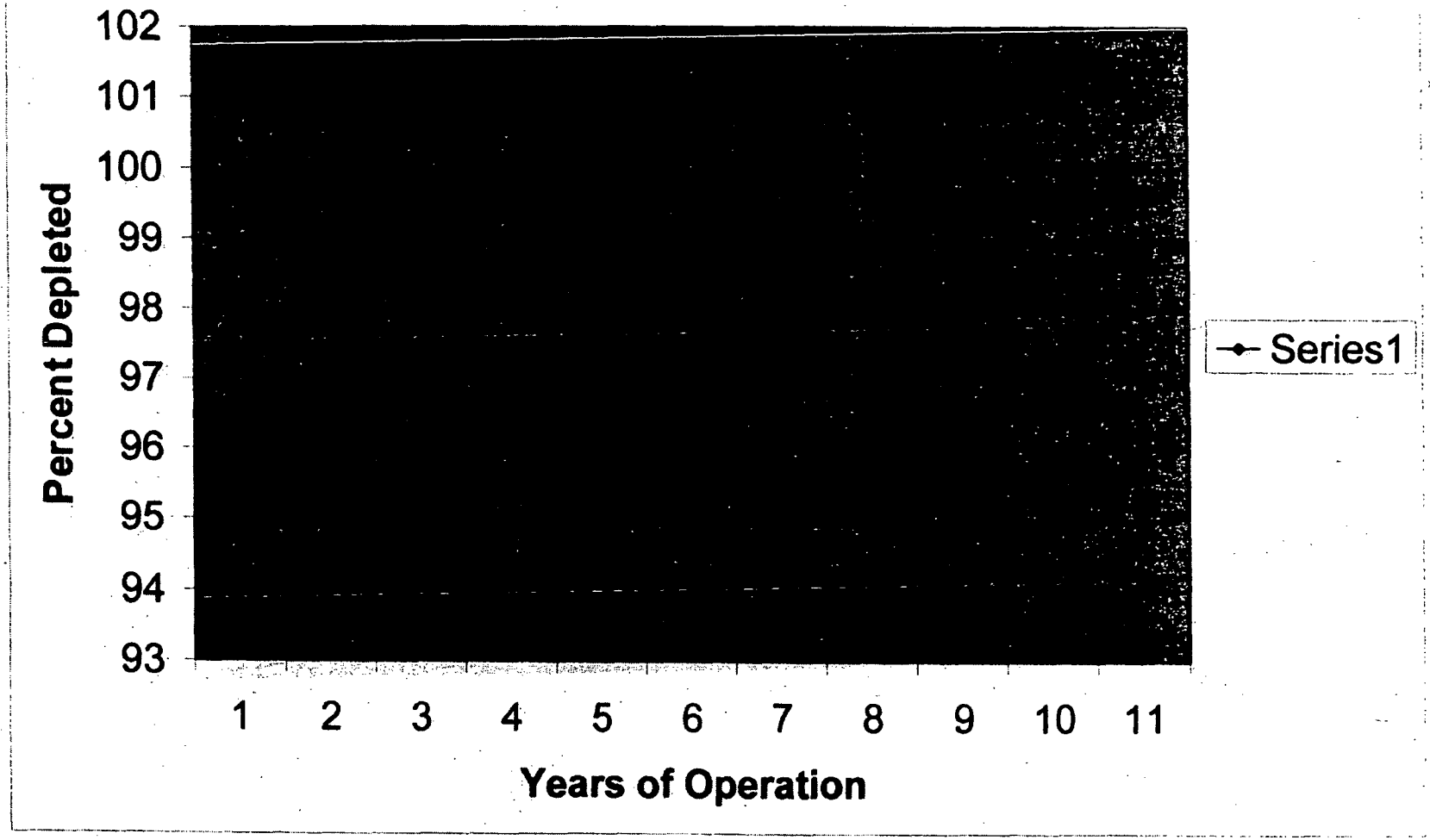
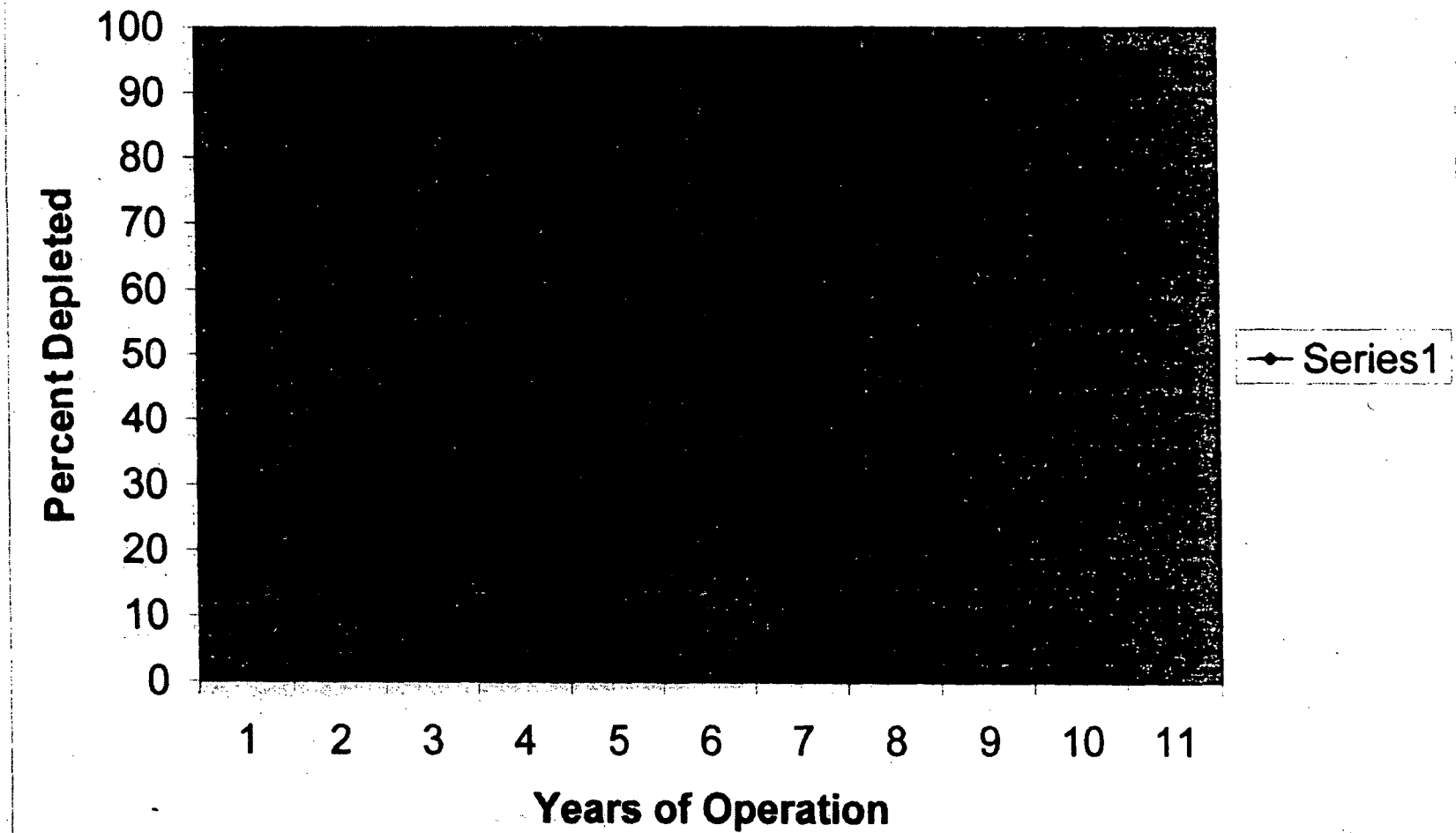


Figure 2, F Wellfield



Report of Investigation

Operator : **Power Resources, Inc.**

Facility : **Smith Ranch - Highland Uranium Project**
Mine Permit #603 (Highland) and #633 (Smith Ranch)

Prepared By : **Mark Moxley, LQD District 2 Supervisor**

Date : **November 21, 2007**

Background:

This investigation was conducted at the request of Rick Chancellor, LQD Administrator, in response to concerns over recent spills and the slow pace of groundwater restoration at the Smith Ranch-Highland ISL operation. PRI's operation is located in Converse county in LQD District 1. An investigator was brought in from LQD District 2 with the intention of having a fresh pair of eyes look at the operation. The investigation was intended to identify and focus on "big picture" issues, not specific details. The investigation proceeded as follows:

- Review of permit documents and annual reports
- Interviews with LQD District 1 staff
- Site tour and interviews with PRI staff
- Interviews with LQD District 3 staff
- Follow-up reviews and discussions

PRI began producing in 1988 and is currently the only significant producer of uranium in Wyoming. They are currently producing at capacity levels (2 million pounds of yellow-cake in 2006 and they are expecting similar production in 2007). PRI has applied for a mine permit amendment to add the Reynolds Ranch property and they are also planning to consolidate the Smith Ranch and Highland permits. This will result in a combined mine permit area some 41,000 acres in size. PRI is planning to increase their throughput capacity next year and add approximately 30 people to their current staff of 100. They are also considering adding facilities to provide toll milling services to process feedstock from other operators.

Given that PRI's operation has for many years been the major uranium producer in Wyoming, there is an expectation that the operation might serve as a model for excellence in ISL mining. Unfortunately, this is not the case. There are a number of major long-standing environmental concerns at this operation that demand immediate attention. Recommendations are made as to how to address these concerns.

Currently the uranium industry is experiencing a major boom. Drilling and pre-permitting investigations are proceeding on many different properties around the state, including several owned by PRI. The LQD is expecting numerous new ISL mine permit applications within the coming 12-18 months. This increase in workload will be a major challenge for the LQD staff. Achieving regulatory effectiveness and efficiency will be a high priority for LQD and it will require the cooperation of the industry.

Major Regulatory Issues and Concerns with Permits 603 & 633:

1. Mine Permit:

The mine permit document is the primary regulatory mechanism governing the operation. The mine and reclamation plan should describe in detail how the operation will be conducted so as to comply with all of the major regulatory requirements. The mine and reclamation plans should be updated and maintained so as to be a definitive reference for the operator, the regulatory agencies, and also the public. Having a definitive mine and reclamation plan is particularly important for new staff. In the case of the Smith Ranch - Highlands operation (mine permits #603 and #633), the plans contained in the permit document are out of date and incomplete in several important areas. The following major deficiencies were noted:

A. The approved mining and reclamation schedules are not being followed and are not current. PRI is not conducting contemporaneous restoration as required by their permit and WDEQ-LQD regulations. See discussion under item 2, below.

B. Spill detection, reporting, delineation, remediation, follow-up and tracking protocols are not defined in the permit and should be. PRI experiences spills on a routine basis. See discussion under item 3 below.

C. Groundwater restoration processes, facilities and procedures (incorporating and defining BPT), flow rates and time schedules should be thoroughly described in the permit so that expectations are clear. This has implications for bonding also.

D. Waste disposal facilities and processes should be clearly defined for all waste streams. One example of inaccurate information in permit #603 (on pages OP-15 and 19) states that byproduct solid waste materials will be disposed at the ANC Gas Hills facility (which closed in 1994). This waste actually goes to the Pathfinder Shirley Basin facility.

E. Construction details and specifications should be thoroughly described for critical process installations, including wells, pipelines, header houses, ponds, etc. One example of inaccurate information in permit #603(on page OP-24)states that well casing joints are fastened with screws. This practice is not consistent with the regulations and was discontinued years ago.

F. Topsoil protection procedures are not adequately defined to assure that disturbance is minimized and that the soil resource is protected. PRI's typical wellfield installation procedures result in the near total disturbance of the native vegetation and soils. This is not consistent with the regulation that allows for "minor disturbance" without topsoil stripping. More definitive procedures should be implemented to restrict and consolidate disturbance from roadways and pipelines and to insure careful topsoil salvage from well sites, mud pits, pipelines, roadways, etc.

With the permit updates required by Chapter 11 and the proposed consolidation of the Highland and Smith Ranch permits, now is an opportune time to correct permit deficiencies and construct a permit that is informative and useful to all parties.

Report of Investigation

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Given that PRI's operation has for many years been the major uranium producer in Wyoming, there is an expectation that the operation might serve as a model for excellence in ISL mining. Unfortunately, this is not the case. There are a number of major long-standing environmental concerns at this operation that demand immediate attention. Recommendations are made as to how to address these concerns.

Currently the uranium industry is experiencing a major boom. Drilling and pre-permitting investigations are proceeding on many different properties around the state, including several owned by PRI. The LQD is expecting numerous new ISL mine permit applications within the coming 12-18 months. This increase in workload will be a major challenge for the LQD staff. Achieving regulatory effectiveness and efficiency will be a high priority for LQD and it will require the cooperation of the industry.

2. Contemporaneous Reclamation:

One of the fundamental requirements for any mining operation is that reclamation be conducted concurrently with mining. Not only is this the most efficient operational strategy but it also insures that the reclamation liability is kept at a reasonable and manageable level. This approach ensures that the public is protected in the event of a forfeiture.

The schedule in permit #603, Highland, dates from 2005. An identical schedule was provided in the July, 2007 annual report. That schedule shows that restoration of the C wellfield should have been completed in 2006 and decommissioning should now be in progress. In actuality the restoration of the C wellfield has been on-going for ten years and the RO treatment phase has only just recently begun. According to the schedule, restoration of the D wellfield should have commenced in 2006 and restoration of the E wellfield should have commenced in early 2007. The annual report states that both the D and E wellfields are still in production. According to the schedule there should now be five wellfields in production (D-ext, F, H, I & J), two in restoration (D & E) and three restored (A, B & C). In fact there are currently 7 wellfields in production, one in restoration (C), and only 2 restored (A & B) at Highland.

The schedule contained in permit #633, Smith Ranch, dates from 1998. A more current schedule was provided in the July, 2007 annual report, yet even this recent schedule is not being followed. According to that schedule, wellfields 1, 3 and 4/4A should now be in restoration. Production from these wellfields was started in 1997, 1998 and 1999 respectively. Restoration of wellfield 1 is to be complete by mid 2008 and restoration in wellfield 2 is to commence in early 2008. However, as reported in the annual report only wellfield 1 is in restoration (no completion date stated) and no mention is made of any other planned restoration. In addition, a new wellfield (K) went into production this year and it does not even appear on the schedule. According to the schedule there should now be three wellfields in production (2, 15 & 15A)and three in restoration (1,3 & 4/4A). In fact there are currently five wellfields in production and only one in restoration. No wellfields have been restored at Smith Ranch.

It is readily apparent that groundwater restoration is not a high priority for PRI. Reclamation is not contemporaneous with mining. A total of 12 wellfields are now in production and restoration is proceeding (slowly) in only 2 wellfields. Only 2 wellfields (A and B) have been restored in 20 years of operation. The permits project that production will typically last for 3-5 years per wellfield and restoration will take 3-5 years per wellfield. It appears in reality that both production and restoration timeframes have doubled or tripled and yet additional wellfields are being brought into production.

It is recommended that a notice of violation be issued to PRI for failure to conduct concurrent reclamation and failure to follow the approved schedules. A rigorous compliance schedule should be implemented to accelerate restoration. A thorough re-evaluation of the operation schedules is warranted. As pointed out below, new deep disposal wells (DDW's) and RO units will be required to support restoration operations. LQD approval of the Reynolds Ranch amendment as well as any new wellfields should be contingent on installation of appropriate DDW's and RO units and completion of restoration in existing wellfields.

3. Spills, Leaks and Excursions:

Over the years there have been an inordinate number of spills, leaks and other releases at this operation. Some 80 spills have been reported, in addition to numerous pond leaks, well casing failures and excursions. Unfortunately, it appears that such occurrences have become routine. The LQD currently has two large three- ring binders full of spill reports from the Smith Ranch - Highland operations.

Protocols for spill detection, reporting, control, delineation, remediation and tracking should be defined in the mine plan to cover all potential fluid types (injection fluids, production fluids, waste fluids, chemicals and petroleum products) and all potential sources (buried pipelines, surface pipelines, wellhead fittings, headerhouses, ponds, well casing failures, etc.). Protocols should include mapping and delineation of the extent of soil and/or groundwater contamination associated with each occurrence. A GIS system should be developed to facilitate long term tracking of all spills and releases. An updated cumulative spill map showing all historic spills and releases should be presented in each annual report along with documentation of follow-up actions. Excursion protocols are addressed in some detail in the permit, but excursions should be tracked on a cumulative basis in the annual report.

Cumulative tracking of spills and releases is important to insure appropriate follow-up on every incident. Some of the spills may have little impact individually, but cumulatively they might have a significant effect on soils and/or groundwater. A cumulative record will also assist in pinpointing potential problem areas and developing appropriate preventative measures. PRI should develop and implement an inspection and maintenance program designed to prevent future spills. Spills should not and need not be an accepted consequence of ISL mining.

4. Reclamation Cost/Bonding:

The reclamation cost estimates contained in PRI's annual reports assume completion of all groundwater and surface reclamation in 4 years with a staff of 26 people (1/4 of current staff), using the existing facilities with the addition of only 2 new 400gpm RO units. This scenario is totally infeasible and unsupported by any critical path timeline or water balance. Rough calculations based primarily on PRI's figures reveal an alarming scenario.

- Adding the pore volumes for all of the existing wellfields gives a total pore volume (PV) for the project (excluding restored wellfields A&B) of 5,133 Ac.Ft.

- PRI's bond calculation includes only one PV of groundwater sweep, vs three PV's specified in the permit. [Removal of this volume of water from the aquifer would be problematic and warrants further evaluation.] PRI's four existing deep disposal wells (DDW's) have a combined capacity of approximately 600gpm (@100% availability). Disposal of one PV would take more than 5 years! This is not an acceptable schedule. A more reasonable scenario would require at least doubling the disposal capacity (1,200gpm), which would require 4 or 5 new DDW's. These would also be needed for disposal of RO brine and should be included in the bond.

- PRI's bond calculation includes only 3 pore volumes of RO treatment. The approved reclamation plan specifies circulation of a total of 6 PV's (3 groundwater sweep and 3 RO). It is likely that at least 5 PV's of RO treatment would be required if only one PV of groundwater sweep was completed. Using the five existing RO units on the site, plus two new 400 gpm units included in the bond calculation, producing a combined total of 1,360gpm of permeate (@80/20 permeate to brine ratio @100% availability), it would take 854 days (2.3 years) to treat one PV! It would take at least 11.5 years to treat 5 pore volumes. This is a not an acceptable schedule. A more realistic reclamation scenario would require increasing the RO capacity by 2-3 times (3,000 - 4,000 gpm permeate production). The additional RO units, as well as the additional building space, ancillary treatment facilities and piping, should be included in the bond.

- Using the existing RO units (plus the two bonded RO units) and existing DDW's, reclamation would take 20+ years, assuming groundwater restoration was achieved without any problems. (5 years for one PV of GW sweep + 11.5 years for 5 PV's of RO treatment + 1 year stability monitoring + 1 year decommissioning + 1 year of surface reclamation). Clearly this is not an acceptable schedule, but it does point out the need for reevaluation of the reclamation plan, restoration schedule and the bond calculation.

- PRI's bond calculation includes minimal funds for new infrastructure, maintenance, replacement and repair. Only two new 400 gpm RO units are included in the bond estimate. The need for new wells, including DDW's, water storage and treatment ponds, additional RO units, membranes, pumps, piping and general wellfield renovation should be anticipated and included in the bond calculation.

- PRI's bond calculation assumes a staff of only 26 people, with 22 of them on a salary of only $34,000 per year! If their current operations require a staff of 100 people then it will take at least 1/2 to 2/3 of that staff to conduct restoration. The restoration operations will look very similar to production operations. Operation of RO units, in particular, is very high maintenance and labor intensive. Retaining competent staff will require that wages and benefits be at least $50,000 per year.

- Considering that reclamation will take several times longer, require at least twice the staff with higher wages and require much greater investments in infrastructure than PRI has estimated, a realistic reclamation cost estimate for this site would likely be on the order of $150 million, as compared to PRI's current calculation of $38,772,800. PRI is presently bonded for a total of only $38,416,500. No bond adjustments have been made since 2002. Clearly the public is not protected. It is recommended that PRI's bond be immediately raised to a level of $80 million until a thorough evaluation, including critical path analysis, can be completed and an appropriate bonding level established. No permit amendments should be approved or new wellfields authorized until the bonding situation is corrected.

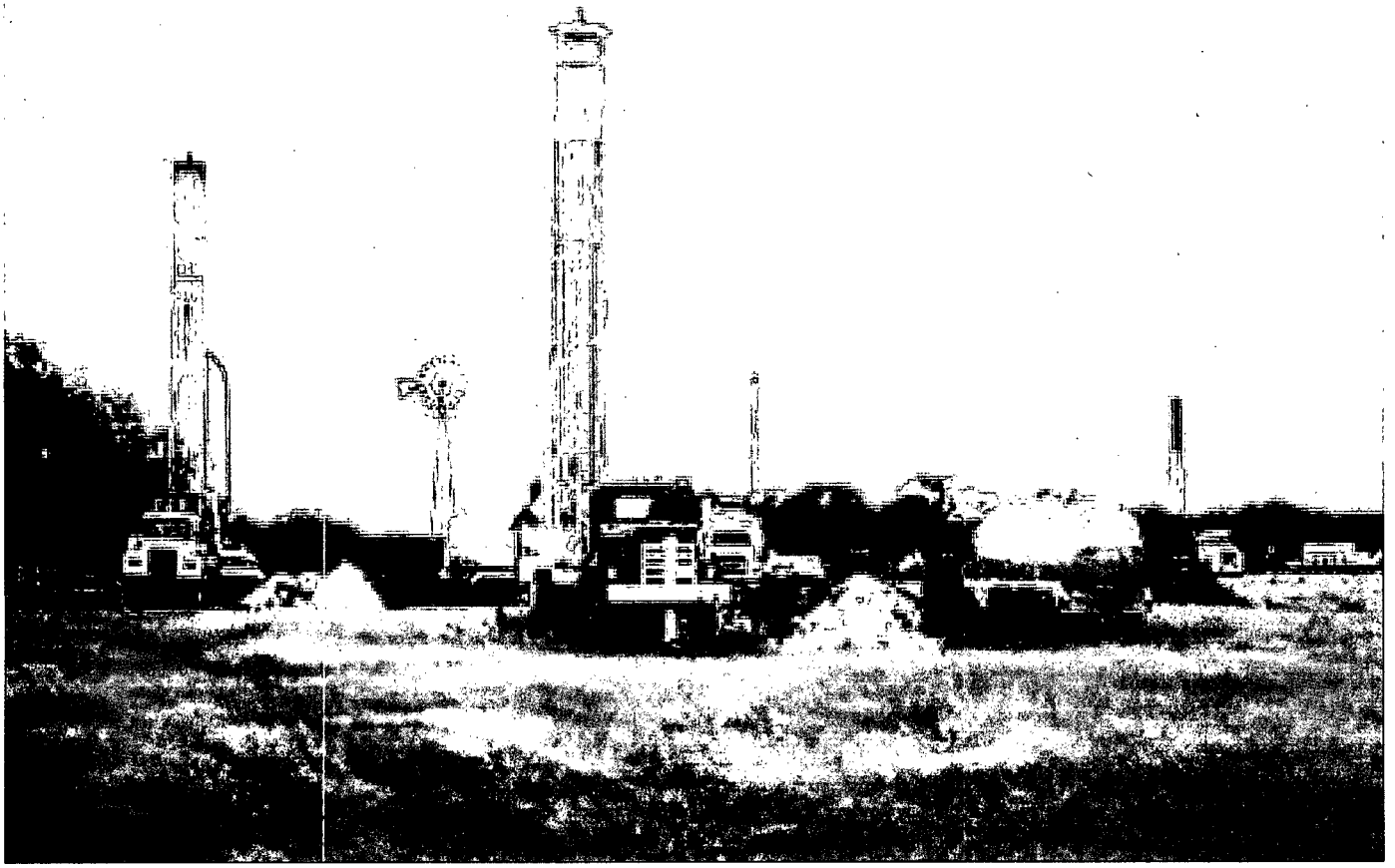
5. Regulatory compliance:

Achieving environmental compliance at an operation of the size and complexity of PRI's Smith Ranch - Highland Mine requires a high level of commitment from both the company and the regulatory agency. PRI's environmental efforts have suffered from inadequate staffing, high turnover, lack of institutional memory and a low level of corporate commitment. There has been a lack of continuity and follow-through on many issues. At this point in time, overall environmental compliance at this operation is poor. PRI should retain a full-time environmental staff of 4-5 qualified people, including a groundwater hydrologist to manage the groundwater restoration. It is recommended that LQD immediately assign a staff person full-time to manage this project as their #1 priority, and that monthly inspections be conducted to get a handle on the issues identified in this investigation.

End of Report

USGS
science for a changing world

Groundwater Restoration at Uranium In-Situ Recovery Mines, South Texas Coastal Plain



Open-File Report 2009–1143

U.S. Department of the Interior
U.S. Geological Survey

Groundwater Restoration at Uranium In-Situ Recovery Mines, South Texas Coastal Plain

By Susan Hall

Open-File Report 2009–1143

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
KEN SALAZAR, Secretary

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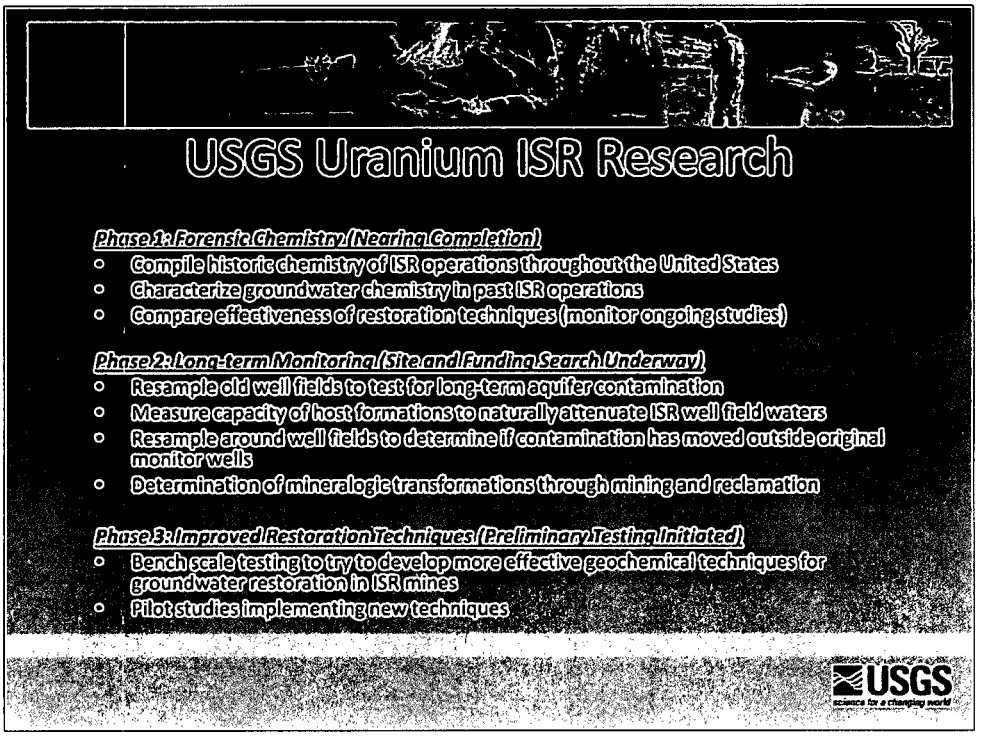
Suggested citation:
Hall, Susan, 2009, Groundwater restoration at uranium in-situ recovery mines, south Texas coastal plain: U.S. Geological Survey Open-File Report 2009–1143, 32 p.

Introduction

This talk was presented by U.S. Geological Survey (USGS) geologist Susan Hall on May 11, 2009, at the Uranium 2009 conference in Keystone, Colorado, and on May 12, 2009, as part of an underground injection control track presentation at the Texas Commission on Environmental Quality (TCEQ) Environmental Trade Fair and Conference in Austin, Texas.

Texas has been the location of the greatest number of uranium in-situ recovery (ISR) mines in the United States and was the incubator for the development of alkaline leach technology in this country. For that reason, the author chose to focus on the effectiveness of restoration at ISR mines by examining legacy mines developed in Texas. The best source for accurate information about restoration at Texas ISR mines is housed at the TCEQ offices in Austin. The bulk of this research is an analysis of those records.



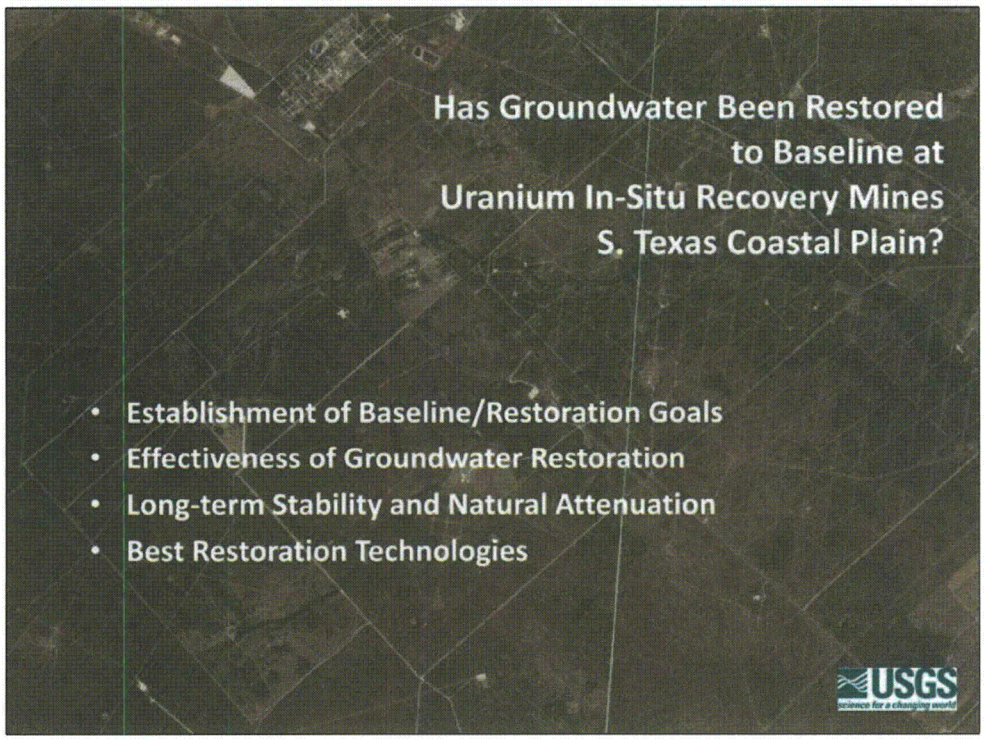
USGS Uranium ISR Studies

The USGS initiated a study of the effects on groundwater by ISR mining in 2008 in response to increased activity in uranium exploration and mining and the increasing number of applications for ISR mines to the U.S. Nuclear Regulatory Commission. USGS geologists were particularly intrigued with the widespread assertion that "Groundwater has never been returned to baseline at any ISR mine."

USGS ISR studies are broken down into three phases:

1. Compilation of forensic chemistry: the examination of legacy projects.
2. Investigations of groundwater chemistry over time.
3. Development of improved restoration techniques.

The USGS is nearing completion of Phase 1, the forensic chemistry portion of our project, and these are some of the interim results of this work. The search for a suitable field site and funding to evaluate long-term impacts and natural attenuation of groundwater in ISR well fields (Phase 2) is underway, and preliminary testing of new restoration technologies for ISR well fields (Phase 3) has begun.



Outline of Presentation

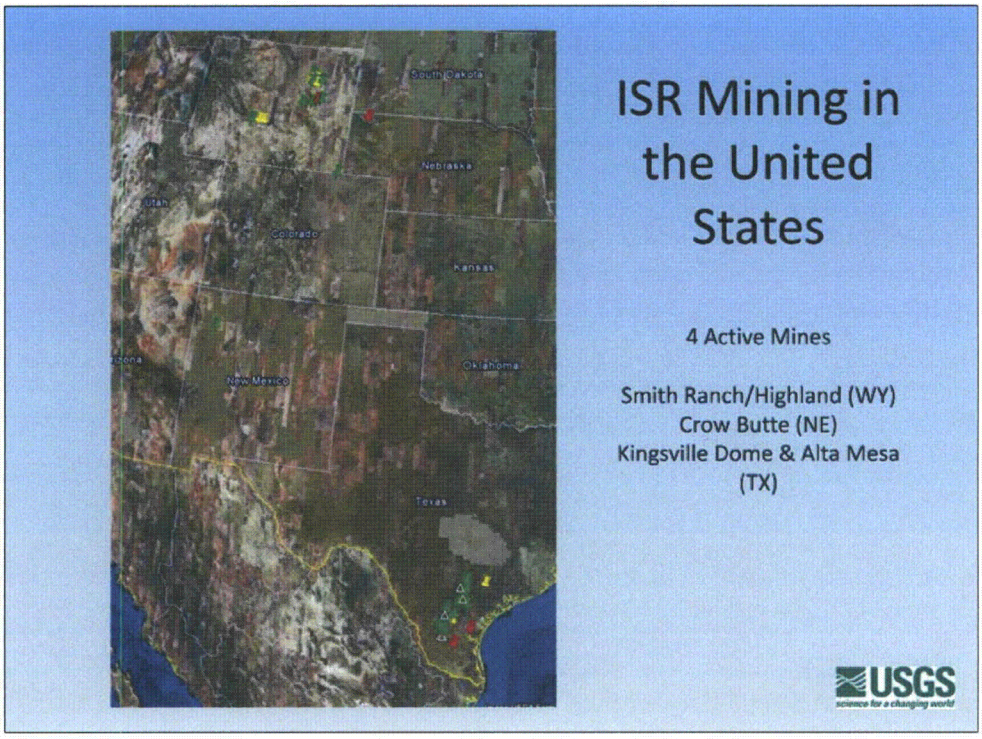
To determine the effectiveness of groundwater restoration at ISR mines, the following topics will be addressed:

1. The establishment of baseline and restoration goals.

2. Effectiveness of groundwater restoration.

3. Long-term stability of well fields.

4. An evaluation of best restoration technologies, including:
   (a) Pump and treat techniques (Texas),
   (b) The addition of reductants (Wyoming and New Mexico), and
   (c) Bioremediation (Nebraska and Wyoming).

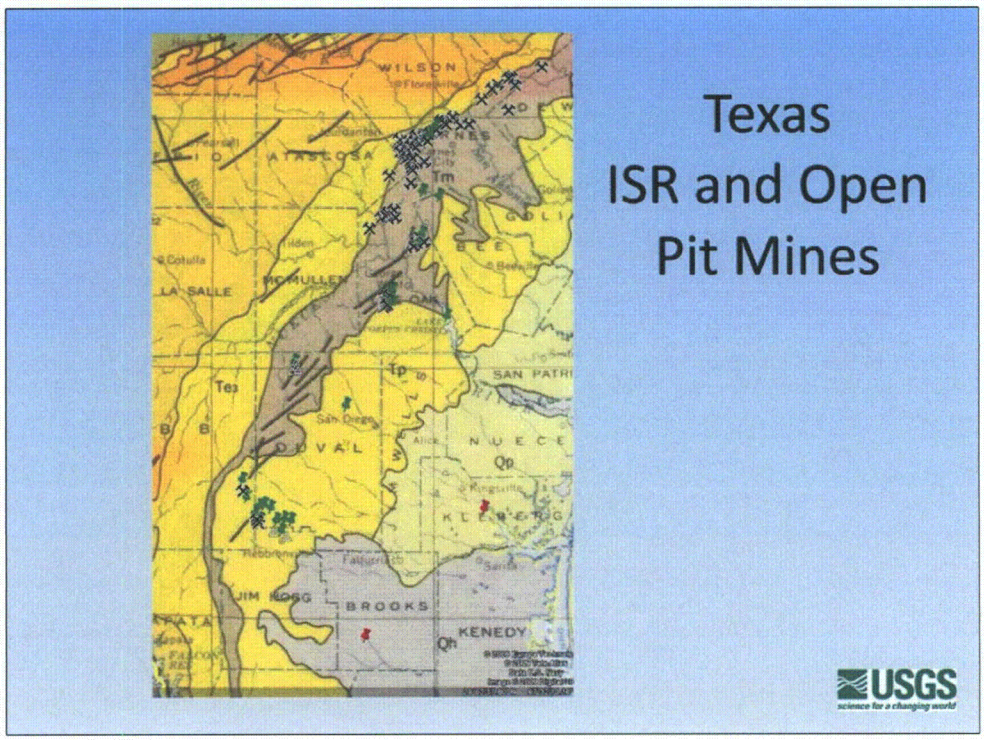


Background

The United States has been steadily producing uranium using ISR mining since the mid-1970s. In April 2009 there were four active mines in the United States (red markers): Cameco's Smith Ranch/Highland property in Wyoming and Crow Butte mine in Nebraska, and Mestena Uranium's Alta Mesa mine and URI's Kingsville Dome mine, both located in Texas.

Most uranium production from ISR mines has come from mines in Wyoming and Texas (green markers), with only pilot projects testing mining and restoration techniques developed in New Mexico (Crown Point, Mobil) and Colorado (Grover, Wyoming Minerals). More than 20 ISR mines anticipate or have begun the process of applying for licensing (yellow markers).

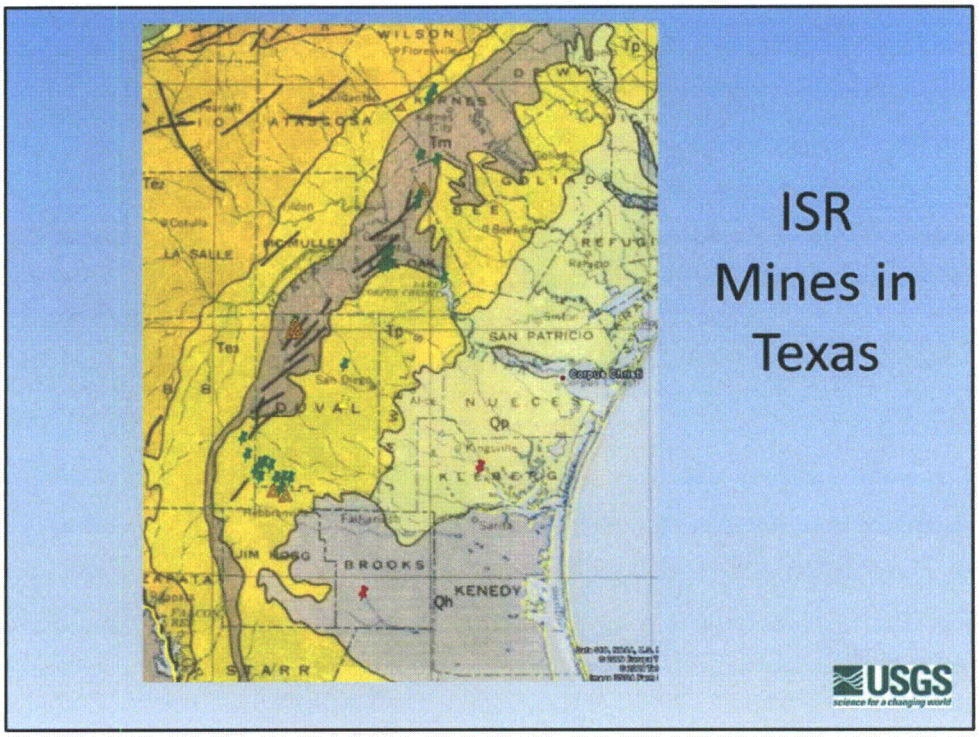
According to the Energy Information Agency, the United States imported 82 percent of its uranium in 2007 (Energy Information Agency, 2009) and 38 percent of U.S. uranium reserves are classified as ISR amenable (Nuclear Energy Agency, 2008). Thus, the safe and effective use of ISR technology in mining uranium deposits is a potentially critical element in the movement towards energy independence in the United States



Texas Coastal Plain Uranium District

Historically, uranium in Texas has been produced from Tertiary units along the southwest coastal plain. Uranium was first mined from a series of open-pit deposits developed in the Whitsett Formation (Jackson Group) and Catahoula Formation, starting in the late 1950s, when uranium was discovered during radiometric surveys in support of oil and gas exploration in Texas.

Black crossed mine symbols are uranium properties identified by the USGS Mineral Resources Data System database (http://tin.er.usgs.gov/) and show mostly historical open-pit mines located near Karnes City, Texas. The green markers represent closed ISR mines, and the red markers indicate operating ISR mines as of April 2009.



Along the southwest Texas coastal plain, uranium is mined, using ISR techniques, from the:

—Goliad Formation (Tp); a series of Miocene mudstone, conglomerates, and limestones, which is host to seven ISR mines

—Oakville Sandstone and Catahoula Formation (Tm); Miocene and Oligocene sandstone, clays, mudstones and Catahoula tuffs hosting 27 mines; 15 mines in the Oakville Sandstone and 13 mines in the Catahoula Formation

—Whitsett Formation (Te, Jackson Group); Oligocene mudstones, sandstones and tuffs which host two mines.

Thirty-six sites were authorized in Texas; seven were never mined (orange triangles), one was a tailings project (white square), and one was combined with another property. This leaves 27 mines (green markers) that were developed by construction of 77 well fields, termed Production Authorization Areas (PAAs) in Texas. The term "well field" and "PAA" will be used interchangeably throughout this presentation. Baseline and "amended restoration" values are available for all 27 mines/ 77 PAAs in TCEQ records.

Currently two mines are active in Texas: the Kingsville Dome mine in Kleberg County, operated by Uranium Resources International (URI), and the Alta Mesa mine in Brooks County, operated by Mestena Uranium (red markers). Two mines are in standby or shut down (green markers): the Vasquez and Rosita mines, both URI properties in Duval County. Two ISR mines are in the process of being permitted (yellow markers): Goliad in Goliad County (Uranium Energy Corporation) and La Palangana, a South Texas Mining Ventures property in Duval County.

Table 1: Baseline Water Quality for Zamzow PAA-1

ATTACHMENT G

BASELINE WATER QUALITY TABLE

TEXAS WATER COMMISSION

GROUND-WATER ANALYSIS REPORT SUMMARY
BASELINE WATER QUALITY--Solution Mining

BASELINE WATER QUALITY TABLE

Company: IEC Corp.
Mine Name: Zamzow
Mine Area: PAA-1 (New and Consolidated)
Date Submitted: October 31, 1988

	PARAMETER	UNIT	NON PRODUCTION ZONE** Low	NON PRODUCTION ZONE** Average	NON PRODUCTION ZONE** High	PRODUCTION ZONE MINE AREA** Low	PRODUCTION ZONE MINE AREA** Average	PRODUCTION ZONE MINE AREA** High	PRODUCTION AREA Low	PRODUCTION AREA Average	PRODUCTION AREA High	WELL I.D. BY AREA* NON PROD. ZONE	WELL I.D. BY AREA* PROD. ZONE Mine	WELL I.D. BY AREA* PROD. ZONE Produc
1	Calcium	mg/l				122	317	552	196	269	390			
2	Magnesium	mg/l				15	38.6	84.2	3.0	21.1	40.		*	*
3	Sodium	mg/l				239	387	750	235	383	454			
4	Potassium	mg/l				19	30.3	49	18.9	24.7	30			
5	Carbonate	mg/l				0	0	0	0	0	0			
6	Bicarbonate	mg/l				128	297	490	157	244	344			
7	Sulfate	mg/l				454	793	1,520	481	601	940			
8	Chloride	mg/l				350	503	936	394	536	662			
9	Fluoride	mg/l				0.16	0.54	1.19	0.01	0.36	0.50			
10	Nitrate-N	mg/l				<0.01	0.16	0.9	<0.01	0.14	0.49			
11	Silica	mg/l				31	51.6	85	11	43.9	74			
12	pH	Std. units				6.6	7.0	7.66	6.68	7.0	7.45			
13	TDS	mg/l				1,697	2,289	3,220	1,810	2,032	2,360			
14	Conductivity	µmhos				2,720	3,204	4,300	2680	3,049	3,430			
15	Alkalinity	$CaCO_3$				105	225	400	206	236	304			
16	Arsenic	mg/l				<0.001	0.003	0.01	<0.001	0.006	0.044			
17	Cadmium	mg/l				<0.0001	0.001	0.002	<0.0002	0.0010	0.0013			
18	Iron	mg/l				0.01	0.915	6.8	0.03	0.075	0.26			
19	Lead	mg/l				<0.001	0.001	0.004	<0.001	0.004	0.02			
20	Manganese	mg/l				0.009	0.224	0.82	0.01	0.118	0.19			
21	Mercury	mg/l				<0.0001	0.0004	0.0018	<0.0001	0.0006	0.001			
22	Selenium	mg/l				<0.001	0.01	0.01	<0.001	0.004	0.01			
23	Ammonia	mg/l				<0.01	0.374	1.3	<0.01	0.298	0.76			
24	Uranium	mg/l				<0.001	0.171	1.7	<0.001	0.039	0.432			
25	Molybdenum	mg/l				<0.001	0.01	0.05	<0.001	0.226	2.1			
26	Radium 226	pCi/l				11.5	195	959	6.5	132	744			

* LIST THE IDENTIFICATION NUMBERS OF WELLS USED TO OBTAIN THE LOW, AVERAGE AND HIGH VALUES. **MONITOR WELLS

USGS science for a changing world

TCEQ ISR Restoration Database

The ISR restoration database is housed in the TCEQ offices in Austin, Texas. The database consists of binders for each mine in a data room adjacent to regulator offices. TCEQ does not represent these data as validated. Official data are on microfiche in an adjacent building, but the data are poorly organized and difficult to search. A digital database, compiled by a retired TCEQ employee, was also made available to the USGS. This digital database was cross-checked against original data sheets from the TCEQ data room, which forms the basis of this research.

TCEQ employees were extremely helpful in allowing the USGS full access to their data and copying facilities and were always available to answer questions about the database or permitting process.

This table is a typical data sheet summarizing pre-mining groundwater baseline data for a Texas PAA. In Texas, 26 chemical constituents are measured before mining to establish a baseline, as shown in Table 1. Restoration values are initially set as baseline, with operators selecting the highest average concentration from either the production or mine area as their restoration goal. At this Zamzow well field, PAA-1, 0.171 milligram per liter uranium was the highest average value from the mine or production area for uranium, as highlighted in Table 1.

Table 2 : Initial Restoration Table for Zamzow PAA-1

Production Area Authorization
Permit No. UR02108-011

Page 3

ATTACHMENT A

RESTORATION TABLE

Parameter	Unit	Concentration
Calcium	mg/l	317
Magnesium	mg/l	38.4
Sodium	mg/l	387
Potassium	mg/l	30.3
Carbonate	mg/l	0
Bicarbonate	mg/l	297
Sulfate	mg/l	793
Chloride	mg/l	538
Fluoride	mg/l	0.54
Nitrate-N	mg/l	0.16
Silica	mg/l	51.6
pH	Std. Unit	7
TDS	mg/l	2,289
Conductivity	µmhos	3,204
Alkalinity	Std. Unit	275
Arsenic	mg/l	0.009
Cadmium	mg/l	0.001
Iron	mg/l	0.915
Lead	mg/l	0.004
Manganese	mg/l	0.224
Mercury	mg/l	0.0006
Selenium	mg/l	0.01
Ammonia	mg/l	0.374
Molybdenum	mg/l	0.226
[illegible]	[illegible]	[illegible]
Uranium	mg/l	0.171

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Table 2 is a copy of the initial restoration table for Zamzow PAA-1. Note that the restoration goal for uranium in groundwater is set as 0.171 milligram per liter, as highlighted on the table, which was the highest average uranium content from the PAA mine area, as shown on Table 1.

Table 3: Amended Restoration Table for Zamzow PAA-1

ATTACHMENT A

RESTORATION TABLE
(Amended)

Parameter	Unit	Concentration
Calcium	mg/l	317.
Magnesium	mg/l	38.4
Sodium	mg/l	450.
Potassium	mg/l	30.3
Carbonate	mg/l	0
Bicarbonate	mg/l	750.
Sulfate	mg/l	793.
Chloride	mg/l	538.
Fluoride	mg/l	0.54
Nitrate-N	mg/l	0.16
Silica	mg/l	51.6
pH	std. units	6.5 - 8.5
TDS	mg/l	2289.
Conductivity	µmhos	3204.
Alkalinity	std. units	500.
Arsenic	mg/l	0.2
Cadmium	mg/l	0.001
Iron	mg/l	0.915
Lead	mg/l	0.004
Manganese	mg/l	0.224
Mercury	mg/l	0.0006
Molybdenum	mg/l	5.
Selenium	mg/l	0.01
Uranium	mg/l	3.
Ammonia-N	mg/l	200.
Radium-226	pCi/l	200.

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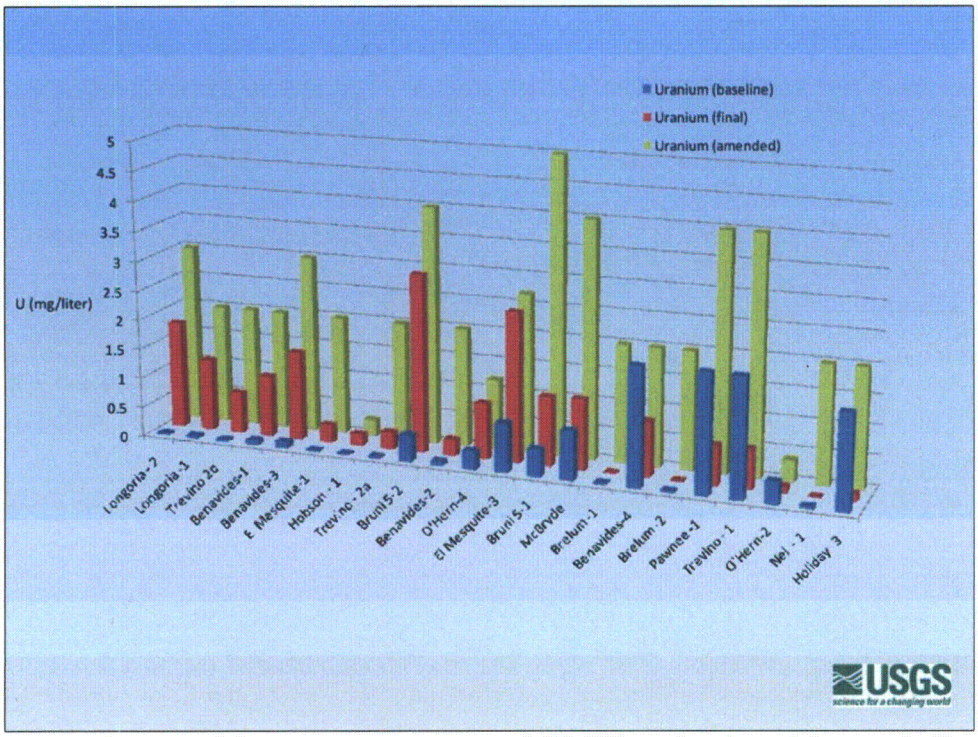
All PAAs in Texas have received amended restoration goals for at least one element after operators have expended a reasonable degree of effort to restore groundwater, as determined by TCEQ regulators, following established guidelines. The final restoration table for Zamzow PAA-1 shows an amended limit of 3.00 milligrams per liter for uranium. This amended restoration value is believed to be a relatively arbitrary value set by the regulators, as illustrated by the number of PAAs that set amended values at rounded whole numbers that were unrelated to any restoration level actually achieved in the PAAs. As there are no "final sample" data for Zamzow PAA-1, no information is available to describe the degree to which this well field was restored.



This graph of uranium concentration for various Texas PAAs illustrates the relationship between baseline, final values, and amended restoration goals in the PAAs where final values were available. The blue bars represent baseline restoration goals for uranium as set by the highest average uranium concentration in baseline samples from either the mine or the production area. Well-field designations are shown on the X-axis of this chart. Red bars represent "final values" for uranium prior to release of the PAAs, and green bars represent amended restoration goals for uranium. There is no clear relationship between the final value achieved for uranium in groundwater at the PAAs, and the amended restoration goals. Amended restoration goals do not reflect the degree of restoration achieved at the PAAs in Texas for which final values are available. Therefore, only those fields for which final values were available were chosen for this analysis.

Only 22 PAAs from 13 mines have final sample values. These 22 PAAs form the basis of the study of restoration at these well fields.

Table 4: Baseline Groundwater in United States ISR Mines – Constituents with EPA MCLs

Baseline Groundwater Characteristics of U.S. Uranium ISL Projects

Chemical Constituent (mg/L unless stated otherwise)	EPA MCL	Texas Baseline Range (71-77 PAAs)	Texas - Number of PAAs Where Average Baseline Exceeds MCL/total # of PAAs & percentage		New Mexico Crown Point ISL Pilot	Colorado Grover ISL Pilot	Wyoming (SR Wf1, CR MU2-6, Irigaray MU1-5)	Nebraska Crow Butte (MU 1-5 & R&D Site)
USEPA Primary Maximum Contaminant Levels (MCLs):								
Arsenic	0.010	0.0010 - 0.2000	45/73	62 %	0.004	0.01	0.006	0.001
Barium	2	-	-	-	0.1	0.03	0.073	0.10
Cadmium	0.005	0.0001 - 0.126	21/73	29%	0.006	0.002	0.016	0.006
Chromium	0.1	-	-	-	0.007	0.003	0.259	0.01
Copper	1.3	-	-	-	0.01	0.06	0.043	0.012
Cyanide	0.2	-	-	-	0.088	-		-
Fluoride	4	0.2 - 2.0	0/73	0%	0.39	0.7	0.307	0.69
Gross Alpha (pCi/L)	15	-	-	-	-	87.67		-
Gross Beta (millirems/year)	4	-	-	-	-	15.23		-
Lead	0.015	0.001 - 1.970	35/73	48%	0.003	0.02	0.038	0.032
Mercury	0.002	0.00003 - 0.44500	6/73	8%	0.00024	0.0002	0.001	0.0007
Nitrate	10	0.01 - 12.0	1/77	1%	0.09	1.4	3.01	0.07
Nitrite	1	-	-	-	-	-	0.168	0.004
Radium ($^{226\&228}$Ra: pCi/L)	5	5.45 - 1536.5	71/71	100%	<14.1	13.4	293.15	405.4
Selenium	0.05	0.001 - 0.600	7/73	10%	0.01	0.01	0.015	0.002
Uranium	0.03	0.002 - 2.913	66/73	90%	0.01	0.086	0.193	0.103

Baseline Characterization of Groundwater in U.S. ISR Well Fields

Baseline standards for all 77 Texas PAAs can be used to characterize Texas ISR well fields that serve as a basis of comparison with baseline values determined for other ISR well fields in the United States. The argument is commonly made that before mining, groundwater in ISR well fields is so contaminated that it should not be used for human consumption. Before mining, these aquifers are typically granted exemptions from the Clean Water Act, termed aquifer exemptions, by the U.S. Environmental Protection Agency (USEPA).

In Texas, more than 25 percent of PAAs are characterized by baseline groundwater above the maximum contaminant level (MCL) for arsenic, cadmium, lead, radium, and uranium (shown highlighted on Table 4). MCL is set by the U.S. Environmental Protection Agency (USEPA; http://www.epa.gov/safewater/contaminants/index.html) for those elements with well-established links to negative human health effects. All PAAs contain radium above MCL, and 90 percent contain uranium above MCL. Although baseline is artificially elevated in this database because the operator is selecting the highest average value within the production or mine area, this value does serve to identify elements of concern in these well fields.

In the Crown Point pilot project in New Mexico, only cadmium was elevated above MCL. At the Grover pilot project in Colorado, baseline water showed gross alpha, gross beta, radium, and uranium above MCL. In Wyoming, averaged values for the Smith Ranch 1, Christensen Ranch 2-6, and Irigaray 1-5 mine units were elevated above MCL for cadmium, chromium, lead, radium, and uranium.
In Nebraska (Crow Butte mine units 1-5 and the Crow Butte R &D site), average cadmium, lead, radium, and uranium were elevated above MCL. Elements above MCL are highlighted in the table.

With the exception of the New Mexico deposit (Crown Point), these well fields are characterized by groundwater elevated in multiple MCLs prior to mining. Radium is almost always elevated above MCL while uranium is typically elevated and cadmium and lead commonly elevated. These well fields would require pretreatment to be used as a source for drinking water.

Table 5: Baseline Groundwater in U.S. ISR Mines – Constituents with EPA Secondary (recommended) Standards

Baseline Groundwater Characteristics of U.S. Uranium ISL Projects

Chemical Constituent (mg/L unless stated otherwise)	EPA Secondary Standard	Texas Baseline Range (71-77 PAAs)	Texas - Number of PAAs Where Average Baseline Exceeds Secondary Standards/total # of PAAs & Percentage (Highlighted if > 25% of PAAs Exceed Secondary Standards)		New Mexico Crown Point ISL Pilot	Colorado Grover ISL Pilot	Wyoming (SR WF1, CR MU2-6, Irigaray MU1-5)	Nebraska Crow Butte (MU 1-5 & R&D Site)
EPA Secondary Recommended Standards:								
Aluminum	0.200	-	-	-	0.02	0.537	0.117	-
Chloride	250	122.5 - 3505.0	64/77	83%	20.3	7	9.8	202.6
Iron	0.30	0.01 - 6.3	32/72	44%	0.67	0.7	0.648	0.04
Manganese	0.05	0.01 - 5.06	37/73	51%	0.05	0.02	0.018	0.03
Silver	0.10	-	-	-	<0.01	0.003	-	-
Sulfate	250	10.3 - 1197	10/77	13%	38	38.3	300	353
Total Dissolved Solids	500	628 - 6349	73/73	100%	357	295	616	1177
Zinc	5	-	-	-	0.01	0.04	0.073	0.017

Recommended secondary standards are set by the USEPA for constituents that, in high enough concentrations, negatively affect the esthetic quality of groundwater, but are not conclusively linked to any negative human health effect. Of those elements for which secondary standards are set by the USEPA, iron, sulfate, and total dissolved solids (TDS) are commonly elevated above recommended levels in pre-mining water at ISR facilities. Chloride and manganese are commonly high in Texas PAAs before mining, while TDS is elevated above the recommended standard in all pre-mining Texas PAAs. Elements elevated above secondary standards are highlighted in Table 5.

Table 6: Baseline Groundwater in U.S. ISR Mines – Constituents with no MCL or Secondary Standard

Baseline Groundwater Characteristics of U.S. Uranium ISR Projects						
Chemical Constituent (mg/L unless stated otherwise)	USEPA MCL	Texas Baseline Range (71-77 PAAs)	New Mexico Crown Point ISR Pilot	Colorado Grover ISR Pilot	Wyoming (ISR WF1, CR MU2-6, Irigaray MU1-5)	Nebraska Crow Butte (MU 1-5 & R&D Site)
No Established MCL or Recommended Secondary Standard:						
Alkalinity (as $CaCO_3$)	-	24 - 349	-	154.7	116.1	-
Ammonia-N	-	0.01 - 7.49	0.47	0.25	0.344	0.26
Bicarbonate	-	125 - 500	228	220.1	171.6	344
Boron	-	-	0.1	0.1	0.1	0.93
Calcium	-	0.2 - 395	5.8	9.1	29.4	12.97
Carbonate	-	0.10 - 38	-	4.31	22.4	369
Cobalt	-	-	<0.05	-		-
Conductivity (umhos/cm)	-	1,110 - 11,160	-	380.7	1051	1947
Magnesium	-	0.48 - 150.0	-	1.1	5.324	3.27
Molybdenum	-	0.01 - 2.53	0.172	0.02	0.100	0.05
Nickel	-	-	0.02	0.2	0.093	0.03
Phosphorous	-	-	-	0.05		-
Potassium	-	6.38 - 101.1	-	4.43	9.810	13.10
Silica	-	15 - 98	-	5.45	10.496	16.7
Sodium	-	174 - 2,356	114	85.2	155	410
Thorium	-	-	-	0.7417		-

Table 6 shows average concentrations and a range of concentrations in Texas PAAs, within pre-mining baseline groundwater for those analytes for which no primary or secondary standards have been set by the USEPA.

Table 7: Groundwater Chemistry of Texas In-situ Uranium Production Authorization Areas
(22 PAAs where final analyses are available)

Analyte	USEPA and TCEQ Drinking Water Standards (mg/l)	Baseline Range	Post-Restoration Range	PAAs with Baseline Above MCL or Recommended Standards	PAAs with Post-Restoration Water Above MCL or Recommended Standards	PAAs Where Post-Restoration Analyses Exceed Baseline	PAAs Where Post-Restoration Analyses are Below Baseline
USEPA and TCEQ Primary Maximum Contaminant Levels (MCLs):							
Arsenic	0.01	.004 - 0.23	.002 - .323	77%	55%	18%	82%
Cadmium	0.005	0.0001 - 0.0126	0.0001 - 0.01	45%	23%	27%	73%
Fluoride	4	0.21 - 1.8	0.29 - 1.6	0%	0%	31%	69%
Lead	0.02	0.003 - 1.97	0.001 - 0.05	81%	18%	9%	91%
Mercury	0.002	0.0001 - 0.445	0.0001 - 0.01	9%	0%	22%	64%
Nitrate	10	0.031 - 10.0	0.001 - 2.8	0%	0%	4%	96%
Selenium	0.05	0.001 - 0.049	0.001 - 0.102	18%	4%	54%	45%
Radium (226 & 228 Ra: Pci/l)	5 pci/l	9.36 - 429.8	5.2 - 149	100%	100%	4%	96%
Uranium	0.03	0.025 - 2.0	0.013 - 3.02	95%	86%	68%	32%
TCEQ Secondary Recommended Standards:							
Sulfate	300	15.8 - 250	78 - 3881	0%	18%	86%	14%
Chloride	300	196.9 - 3505	138 - 3326	86%	86%	22%	78%
Total Dissolved Solids	1000	785.7 - 6349	706.3 - 6155	81%	77%	31%	55%
Iron	0.3	0.04 - 5.49	0.01 - 2.7	54%	9%	4%	96%
Manganese	0.05	0.01 - 0.41	0.01 - 0.84	77%	50%	40%	60%
No Established MCL or Secondary Standards							
Calcium	-	4.13 - 241	14.7 - 191			77%	23%
Magnesium	-	0.477 - 125	2.27 - 53			72%	28%
Sodium	-	200 - 2356	169 - 2247			31%	65%
Potassium	-	6.38 - 101	6.1 - 70			14%	86%
Carbonate	-	0.1 - 17.9	0 - 14.6			50%	30%
Bicarbonate	-	160 - 500	160 - 500			66%	25%
Silica	-	16.3 - 76	13.4 - 77.6			19%	81%
Conductivity (umhos/cm)	-	1310 - 11160	1429 - 3697			76%	24%
Alkalinity (as CaCO3)	-	134 - 349	145 - 408			81%	10%
Molybdenum	-	0.01 - 0.2	0.0001 - 3.38			42%	54%
Ammonia-N	-	0.01 - 7.49	0.04 - 120			76%	24%

Baseline and post-restoration data was available for all 22 PAAs with the exception of: Ra, Mo, K, Si, Bicarbonate, Ammonia (21); Conductivity (14); Alkalinity (11) & Carbonate (10)

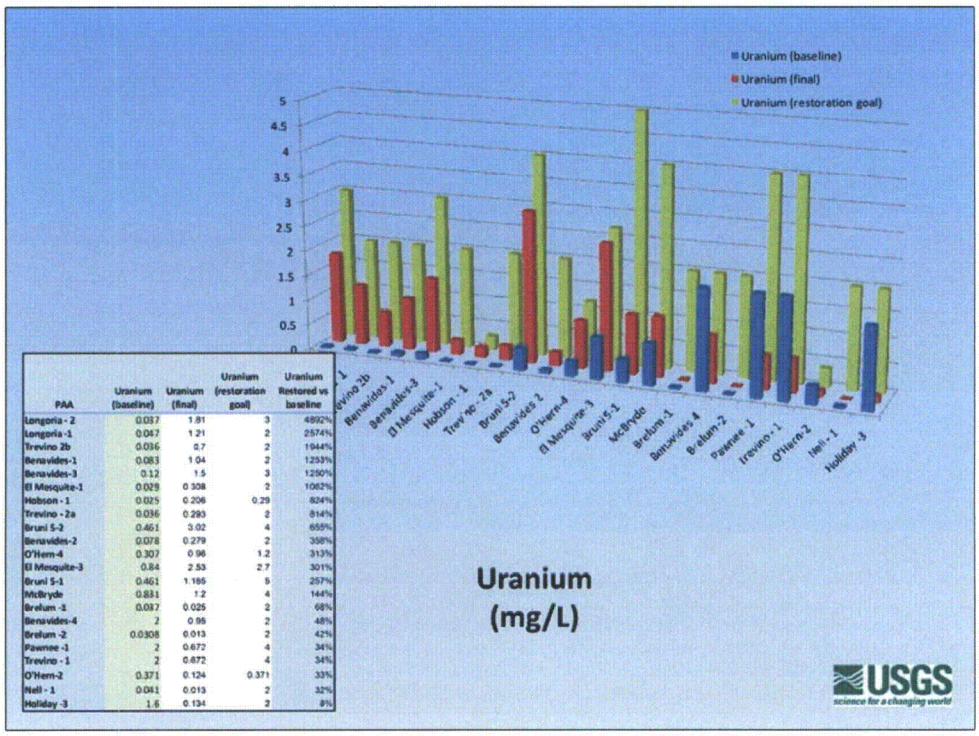
Restoration Results for Texas PAAs

Table 7 shows the average value, post-restoration, and baseline ranges of chemical constituents for all 22 well fields that have post-restoration analyses in the TCEQ records.

In general, at PAAs where post-restoration values exceed MCL, the elements elevated in baseline values (As, Cd, Pb, Se, Ra, and U) continue to be elevated after mining.

As compared to baseline values for the PAAs, uranium and selenium are elevated in the majority of PAAs. More than half of PAAs show a decrease in As, Cd, Fl, Pb, Hg, nitrate, and Ra after mining.

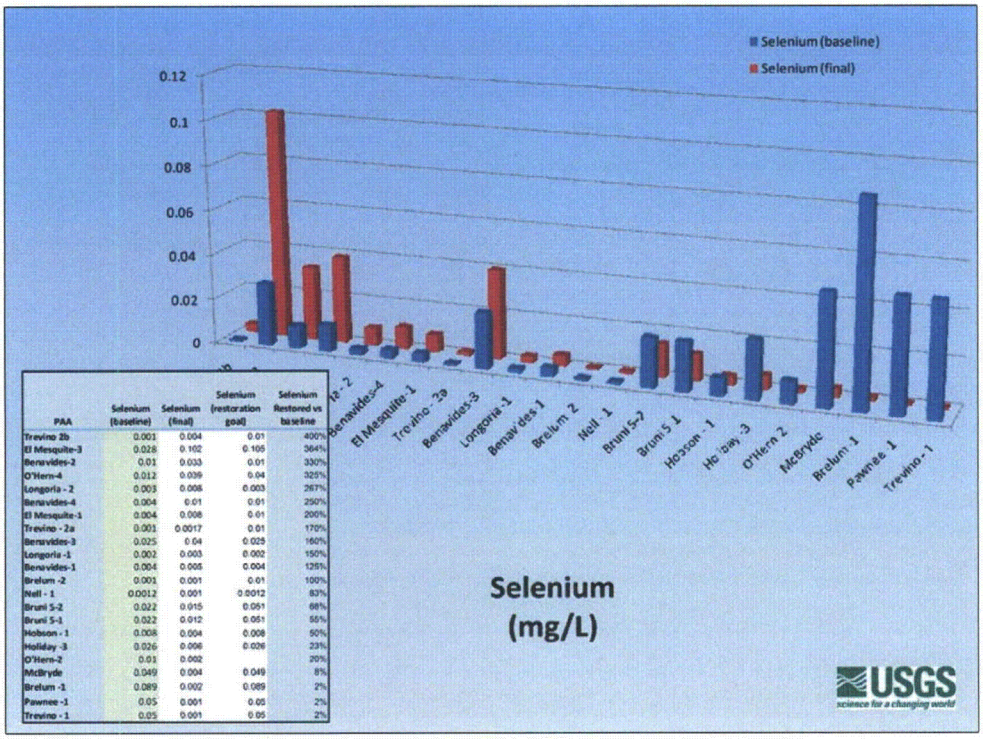
The following slides examine these trends in detail.



PAA	Uranium (baseline)	Uranium (final)	Uranium (restoration goal)	Uranium Restored vs baseline
Longoria - 2	0.037	1.81	3	4892%
Longoria -1	0.047	1.21	2	2574%
Trevino 2b	0.036	0.7	2	1944%
Benavides-1	0.083	1.04	2	1253%
Benavides-3	0.12	1.5	3	1250%
El Mesquite-1	0.029	0.308	2	1062%
Hobson - 1	0.025	0.206	0.29	824%
Trevino - 2a	0.036	0.293	2	814%
Bruni 5-2	0.461	3.02	4	655%
Benavides-2	0.078	0.279	2	358%
O'Hern-4	0.307	0.96	1.2	313%
El Mesquite-3	0.84	2.53	2.7	301%
Bruni 5-1	0.461	1.185	5	257%
McBryde	0.831	1.2	4	144%
Brelum -1	0.037	0.025	2	68%
Benavides-4	2	0.95	2	48%
Brelum -2	0.0308	0.013	2	42%
Pawnee -1	2	0.672	4	34%
Trevino - 1	2	0.672	4	34%
O'Hern-2	0.371	0.124	0.371	33%
Nell - 1	0.041	0.013	2	32%
Holiday -3	1.6	0.134	2	8%

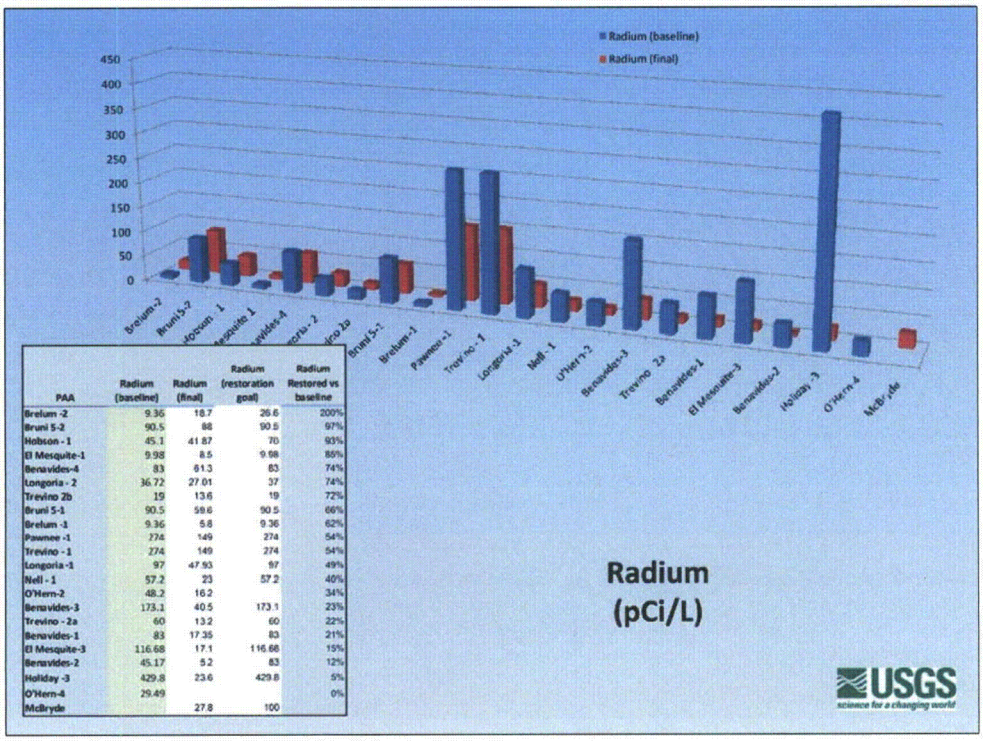
The USEPA-established MCL for uranium in drinking water is 0.03 milligram per liter. Ninety-five percent of Texas PAAs have a baseline value above MCL. Only the Hobson-1 and El Mesquite–1 PAAs were below the MCL for uranium and El Mesquite "rounded out" to equal MCL.

Eighty-six percent of Texas PAAs show a final restoration above MCL. In 68 percent of PAAs, final value exceeded baseline, and in 32 percent of PAAs, restoration was below baseline for uranium.



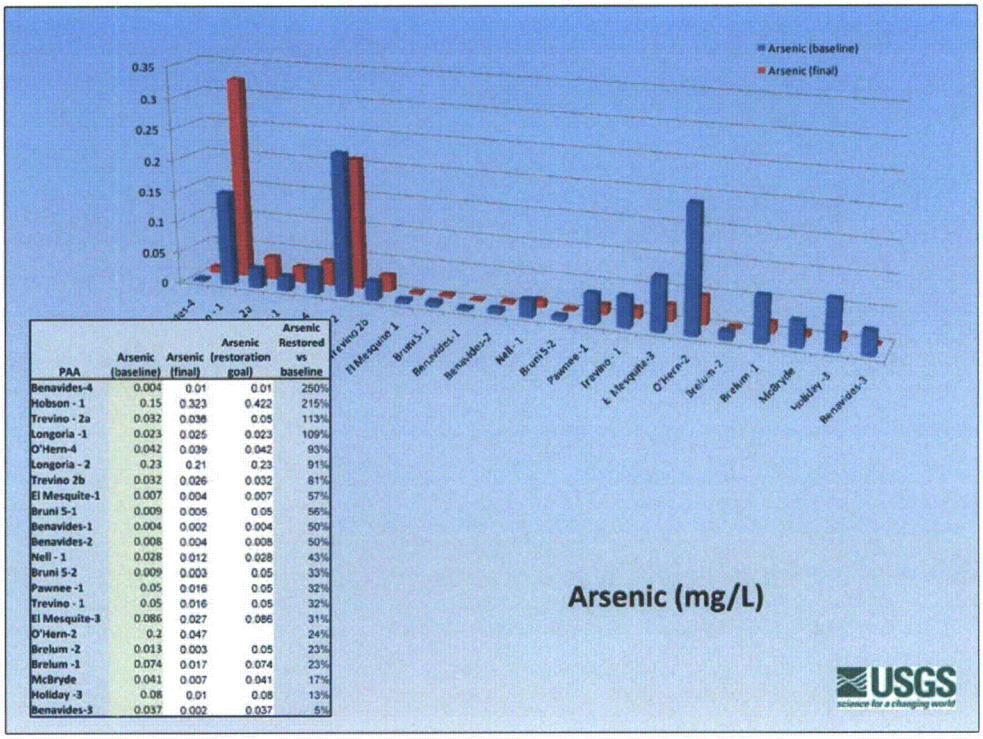
PAA	Selenium (baseline)	Selenium (final)	Selenium (restoration goal)	Selenium Restored vs baseline
Trevino 2b	0.001	0.004	0.01	400%
El Mesquite-3	0.028	0.102	0.105	364%
Benavides-2	0.01	0.033	0.01	330%
O'Hern-4	0.012	0.039	0.04	325%
Longoria - 2	0.003	0.008	0.003	267%
Benavides-4	0.004	0.01	0.01	250%
El Mesquite-1	0.004	0.008	0.01	200%
Trevino - 2a	0.001	0.0017	0.01	170%
Benavides-3	0.025	0.04	0.025	160%
Longoria -1	0.002	0.003	0.002	150%
Benavides-1	0.004	0.005	0.004	125%
Brelum -2	0.001	0.001	0.01	100%
Nell - 1	0.0012	0.001	0.0012	83%
Bruni 5-2	0.022	0.015	0.051	68%
Bruni 5-1	0.022	0.012	0.051	55%
Hobson - 1	0.008	0.004	0.008	50%
Holiday -3	0.026	0.006	0.026	23%
O'Hern-2	0.01	0.002		20%
McBryde	0.049	0.004	0.049	8%
Brelum -1	0.089	0.002	0.089	2%
Pawnee -1	0.05	0.001	0.05	2%
Trevino - 1	0.05	0.001	0.05	2%

The MCL for selenium is 0.05 milligram per liter in drinking water. In 18 percent of PAAs, baseline of groundwater was above MCL, and in 24 percent of PAAs, the final restoration value was above MCL. After mining and restoration, 55 percent of PAAs exceeded baseline and 45 percent of PAAs were below baseline.



PAA	Radium (baseline)	Radium (final)	Radium (restoration goal)	Radium Restored vs baseline
Brelum -2	9.36	18.7	26.6	200%
Bruni 5-2	90.5	88	90.5	97%
Hobson - 1	45.1	41.87	70	93%
El Mesquite-1	9.98	8.5	9.98	86%
Benavides-4	83	61.3	83	74%
Longoria - 2	36.72	27.01	37	74%
Trevino 2b	19	13.6	19	72%
Bruni 5-1	90.5	59.6	90.5	66%
Brelum -1	9.36	5.8	9.36	62%
Pawnee -1	274	149	274	54%
Trevino - 1	274	149	274	54%
Longoria -1	97	47.93	97	49%
Nell - 1	57.2	23	57.2	40%
O'Hern-2	48.2	16.2		34%
Benavides-3	173.1	40.5	173.1	23%
Trevino - 2a	60	13.2	60	22%
Benavides-1	83	17.35	83	21%
El Mesquite-3	116.68	17.1	116.68	15%
Benavides-2	45.17	5.2	83	12%
Holiday -3	429.8	23.6	429.8	5%
O'Hern-4	29.49			0%
McBryde		27.8	100	

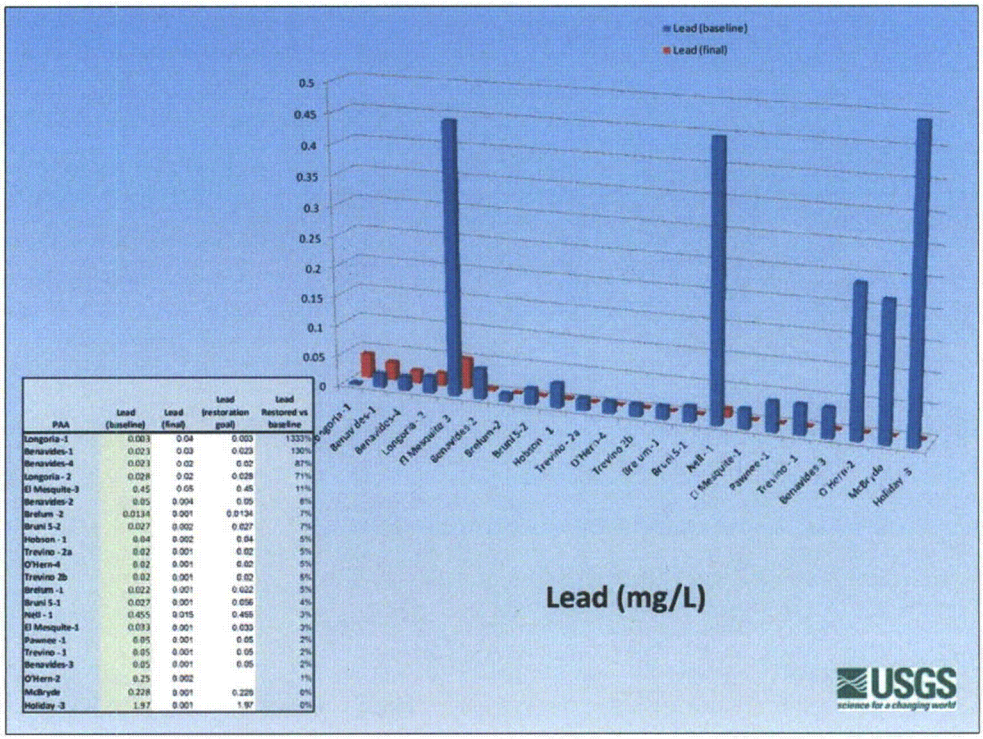
The MCL for radium (^{226}Ra and ^{228}Ra) is 5 pCi/L in drinking water. All PAAs are characterized by baseline and post-restoration radium concentrations above MCL.
After mining and restoration, 4 percent of PAAs were above baseline, and 96 percent of PAAs were below baseline.



PAA	Arsenic (baseline)	Arsenic (final)	Arsenic (restoration goal)	Arsenic Restored vs baseline
Benavides-4	0.004	0.01	0.01	250%
Hobson - 1	0.15	0.323	0.422	215%
Trevino - 2a	0.032	0.036	0.05	113%
Longoria -1	0.023	0.025	0.023	109%
O'Hern-4	0.042	0.039	0.042	93%
Longoria - 2	0.23	0.21	0.23	91%
Trevino 2b	0.032	0.026	0.032	81%
El Mesquite-1	0.007	0.004	0.007	57%
Bruni 5-1	0.009	0.005	0.05	56%
Benavides-1	0.004	0.002	0.004	50%
Benavides-2	0.008	0.004	0.008	50%
Nell - 1	0.028	0.012	0.028	43%
Bruni 5-2	0.009	0.003	0.05	33%
Pawnee -1	0.05	0.016	0.05	32%
Trevino - 1	0.05	0.016	0.05	32%
El Mesquite-3	0.086	0.027	0.086	31%
O'Hern-2	0.2	0.047		24%
Brelum -2	0.013	0.003	0.05	23%
Brelum -1	0.074	0.017	0.074	23%
McBryde	0.041	0.007	0.041	17%
Holiday -3	0.08	0.01	0.08	13%
Benavides-3	0.037	0.002	0.037	5%

The MCL for arsenic is 0.01 milligram per liter in drinking water. Before mining, 77 percent of PAAs showed arsenic above the MCL, and after restoration 55 percent of PAAs were above the MCL.

After restoration, 18 percent of PAAs exceeded baseline and 82 percent of PAAs were below baseline.



PAA	Lead (baseline)	Lead (final)	Lead (restoration goal)	Lead Restored vs. baseline
Longoria-1	0.003	0.04	0.003	1333%
Benavides-1	0.023	0.03	0.023	130%
Benavides-4	0.023	0.02	0.02	87%
Longoria-2	0.028	0.02	0.028	71%
El Mesquite-3	0.45	0.05	0.45	11%
Benavides-2	0.05	0.004	0.05	8%
Brelum -2	0.0134	0.001	0.0134	7%
Bruni 5-2	0.027	0.002	0.027	7%
Hobson - 1	0.04	0.002	0.04	5%
Trevino -2a	0.02	0.001	0.02	5%
O'Hern-4	0.02	0.001	0.02	5%
Trevino 2b	0.02	0.001	0.02	5%
Brelum -1	0.022	0.001	0.022	5%
Bruni 5-1	0.027	0.001	0.056	4%
Nell - 1	0.455	0.015	0.455	3%
El Mesquite-1	0.033	0.001	0.033	3%
Pawnee -1	0.05	0.001	0.05	2%
Trevino - 1	0.05	0.001	0.05	2%
Benavides-3	0.05	0.001	0.05	2%
O'Hern-2	0.25	0.002		1%
McBryde	0.228	0.001	0.228	0%
Holiday -3	1.97	0.001	1.97	0%

The MCL for lead is 0.02 milligram per liter in drinking water. Eighty-one percent of PAAs have baseline levels above MCL, and 18 percent of PAAs are characterized by final restoration values above MCL.

After mining and reclamation, 9 percent of PAAs were above baseline and 91 percent of PAAs were below baseline.

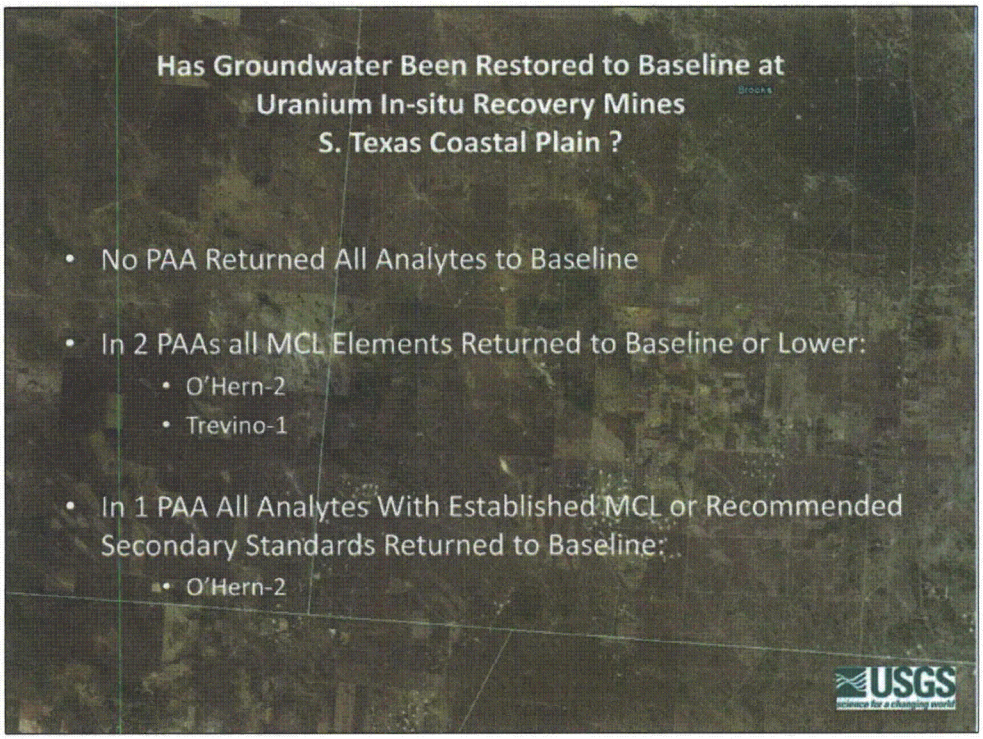
Table 7: Ground-water Chemistry of Texas In-situ Uranium Production Authorization Areas
(22 PAAs where final analyses are available)

Analyte	USEPA & TCEQ Drinking Water Standards (mg/L)	Baseline Range	Post-Restoraton Range	PAAs with Baseline Above MCL or Recommended Standards	PAAs with Post-Restoration Water Above MCL or Recommended Standards	PAAs Where Post-Restoration Analyses Exceed Baseline	PAAs Where Post-Restoration Analyses are Below Baseline
USEPA & TCEQ Primary Maximum Contaminant Levels (MCLs):							
Arsenic	0.01	.004 - 0.23	.002 - .323	77%	55%	18%	82%
Cadmium	0.005	0.0001 - 0.0126	0.0001 - 0.01	45%	23%	27%	73%
Fluoride	4	0.21 - 1.8	0.29 - 1.6	0%	0%	31%	69%
Lead	0.02	0.003 - 1.97	0.001 - 0.05	81%	18%	9%	91%
Mercury	0.002	0.0001 - 0.445	0.0001 - 0.01	9%	0%	22%	64%
Nitrate	10	0.031 - 10.0	0.001 - 2.8	0%	0%	4%	96%
Selenium	0.05	0.001 - 0.049	0.001 - 0.102	18%	4%	54%	45%
Radium (226 & 228 Ra: Pci/L)	5 Pci/L	9.36 - 429.8	5.2 - 149	100%	100%	4%	96%
Uranium	0.03	0.025 - 2.0	0.013 - 3.02	95%	86%	68%	32%
TCEQ Secondary Recommended Standards:							
Sulfate	300	15.8 - 250	78 - 3881	0%	18%	86%	14%
Chloride	300	196.9 - 3505	138 - 3326	86%	86%	22%	78%
Total Dissolved Solids	1000	785.7 - 6349	706.3 - 6155	81%	77%	31%	55%
Iron	0.3	0.04 - 5.49	0.01 - 2.7	54%	9%	4%	96%
Manganese	0.05	0.01 - 0.41	0.01 - 0.84	77%	50%	40%	60%
No Established MCL or Recommended/Secondary Standard:							
Calcium	-	4.13 - 241	14.7 - 191			77%	23%
Magnesium	-	0.477 - 125	2.27 - 53			72%	28%
Sodium	-	200 - 2356	169 - 2247			31%	65%
Potassium	-	6.38 - 101	6.1 - 70			14%	86%
Carbonate	-	0.1 - 17.9	0 - 14.6			50%	30%
Bicarbonate	-	160 - 500	160 - 500			66%	25%
Silica	-	16.3 - 76	13.4 - 77.6			19%	81%
Conductivity (umhos/cm)	-	1310 - 11160	1429 - 3697			76%	24%
Alkalinity (as CaCO3)	-	134 - 349	145 - 408			81%	10%
Molybdenum	-	0.01 - 0.2	0.0001 - 3.38			42%	54%
Ammonia-N	-	0.01 - 7.49	0.04 - 120			76%	24%

Baseline and post-restoration data was available for all 22 PAAs with the exception of: Ra, Mo, K, Si, Bicarbonate, Ammonia (21), Conductivity (14); Alkalinity (11) & Carbonate (10)

Although restoration results vary widely for individual well fields, among the elements with an MCL, only selenium and uranium show overall increases in post-restoration groundwater in more than 50 percent of PAAs (Table 7). Of constituents for which secondary standards are established by the USEPA, sulfate increased in the majority of well fields after mining and restoration, whereas chloride, TDS, iron, and manganese decreased in the majority of well fields.

Of those chemical constituents for which there are no established MCLs or secondary standards, calcium, magnesium, bicarbonate, conductivity, carbonate, alkalinity and ammonia increased; sodium, potassium and silica decreased in the majority of well fields after mining and restoration. Statistically, molybdenum decreased in the small majority of well fields after mining.



Regarding the original question of whether or not groundwater has been restored to baseline in Texas uranium ISR well fields, it was observed that no well field for which final sample results were found in TCEQ records returned every element to baseline. However, two PAAs returned all elements for which USEPA has established MCLs to baseline: the O'Hern-2 and Trevino-1 PAAs.

Trevino-1, which was mined from the Oakville Sandstone and restored using electrodialysis, shows restored sulfate to 164 percent of baseline. Reclamation at O'Hern-2 returned constituents with secondary standards or MCLs to baseline values or below.

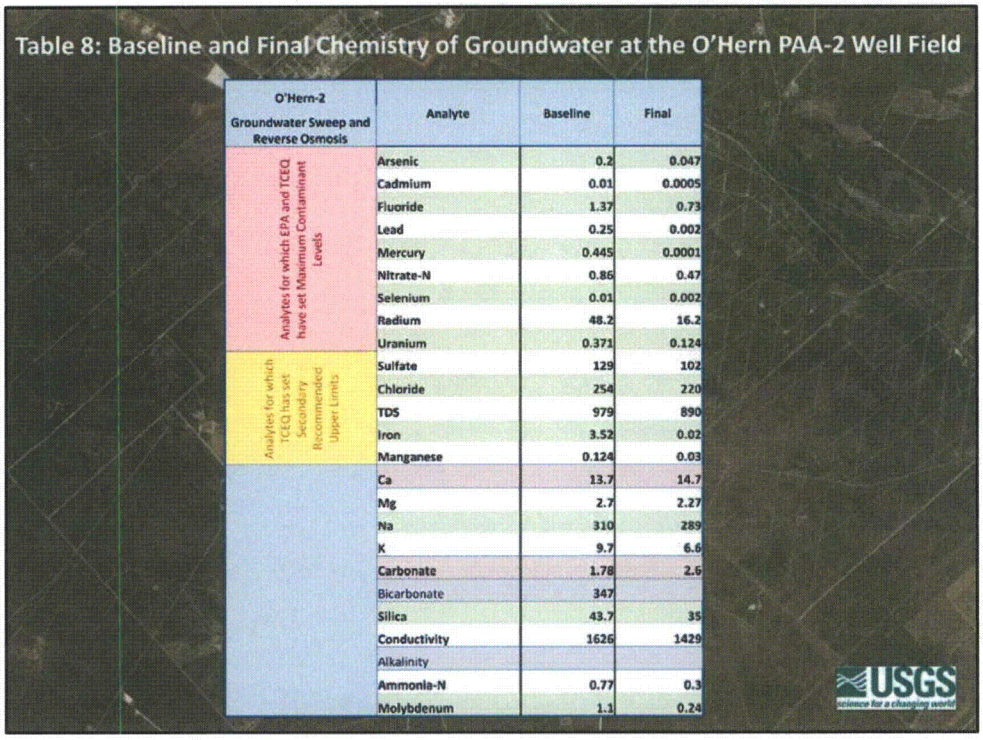


Table 8: Baseline and Final Chemistry of Groundwater at the O'Hern PAA-2 Well Field

O'Hern-2 Groundwater Sweep and Reverse Osmosis	Analyte	Baseline	Final
Analytes for which EPA and TCEQ have set Maximum Contaminant Levels	Arsenic	0.2	0.047
	Cadmium	0.01	0.0005
	Fluoride	1.37	0.73
	Lead	0.25	0.002
	Mercury	0.445	0.0001
	Nitrate-N	0.86	0.47
	Selenium	0.01	0.002
	Radium	48.2	16.2
	Uranium	0.371	0.124
Analytes for which TCEQ has set Secondary Recommended Upper Limits	Sulfate	129	102
	Chloride	254	220
	TDS	979	890
	Iron	3.52	0.02
	Manganese	0.124	0.03
	Ca	13.7	14.7
	Mg	2.7	2.27
	Na	310	289
	K	9.7	6.6
	Carbonate	1.78	2.6
	Bicarbonate	347	
	Silica	43.7	35
	Conductivity	1626	1429
	Alkalinity		
	Ammonia-N	0.77	0.3
	Molybdenum	1.1	0.24

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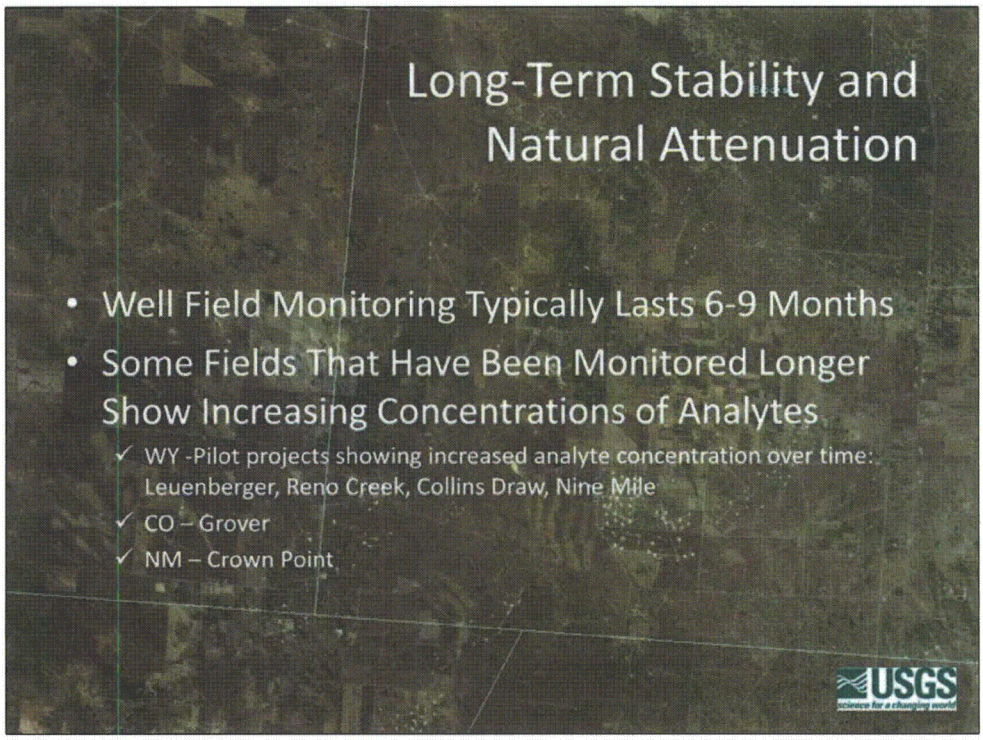
Specifically looking at restoration details from the O'Hern PAA-2 , this well field was developed by Cogema from 1979 to1982 in the Catahoula Formation. Groundwater sweep and reverse osmosis were both used to restore groundwater after mining. Calcium and carbonate were both slightly elevated above baseline following mining and reclamation, as shown in Table 8 above.

The aquifer overlying O'Hern-2 is characterized by an average calcium of 27 milligrams per liter and carbonate of 10.1 milligrams per liter, so post-restoration elevation of these elements in the O'Hern-2 PAA seems inconsequential in the scheme of local hydrochemistry. No final values for bicarbonate or alkalinity were reported, so the specific degree to which this PAA was restored is unknown.

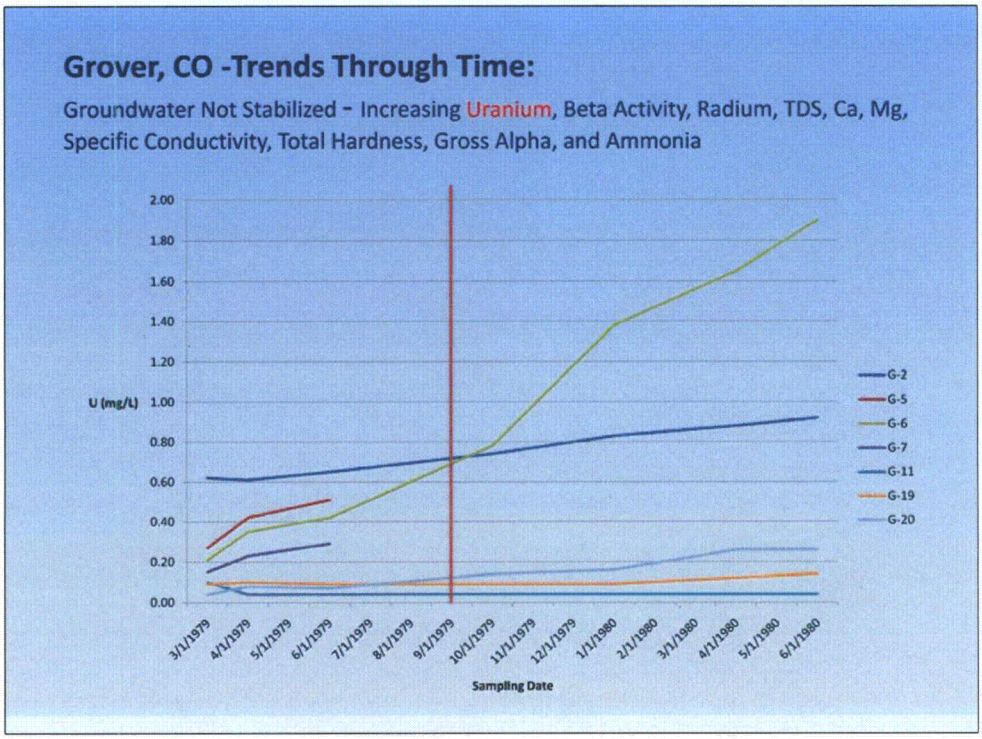
There is a notation in the TCEQ database that O'Hern PAA-3 did not receive any amendments. However, this could not be corroborated by TCEQ records.



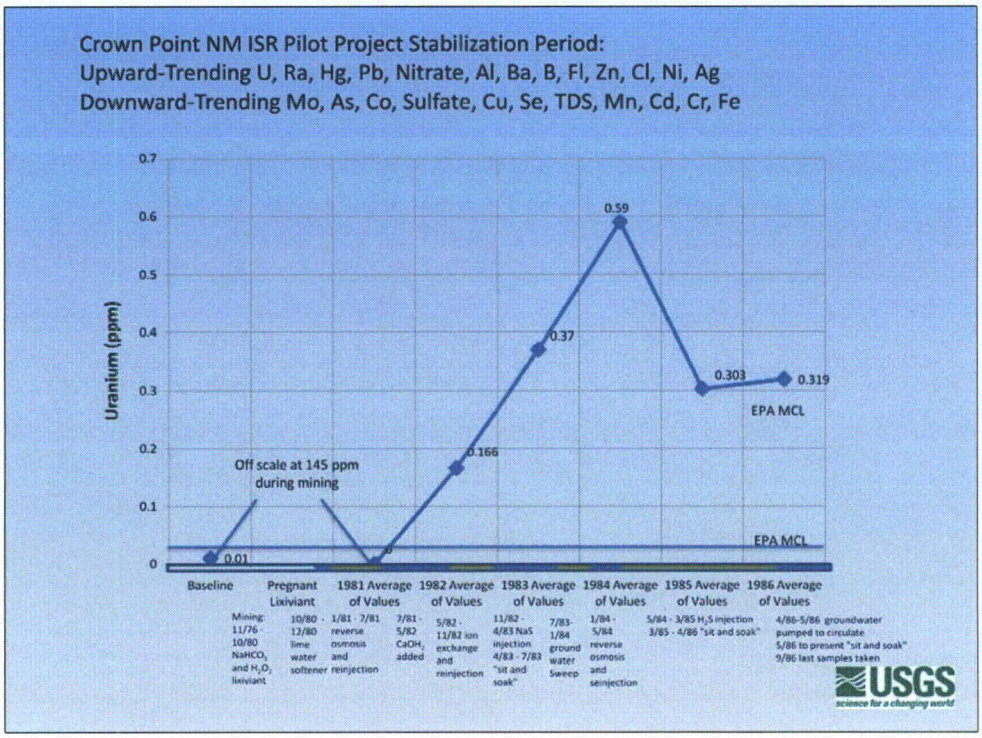
Long-Term Stability and Natural Attenuation

In Texas, after ISR mining ceased and restoration of the well fields was completed, PAAs were monitored for a minimum of 6 months. This period of monitoring has recently been increased to one year if no amendments to the restoration table are requested, and to two years if the operator requests an amendment to the restoration table.

Some well fields monitored for longer periods of time during the post-mining and remediation stability period show trends of increasing analyte concentration, as noted by USGS geologists while examining records at pilot projects in Colorado (Grover), New Mexico (Crown Point), and throughout Wyoming.

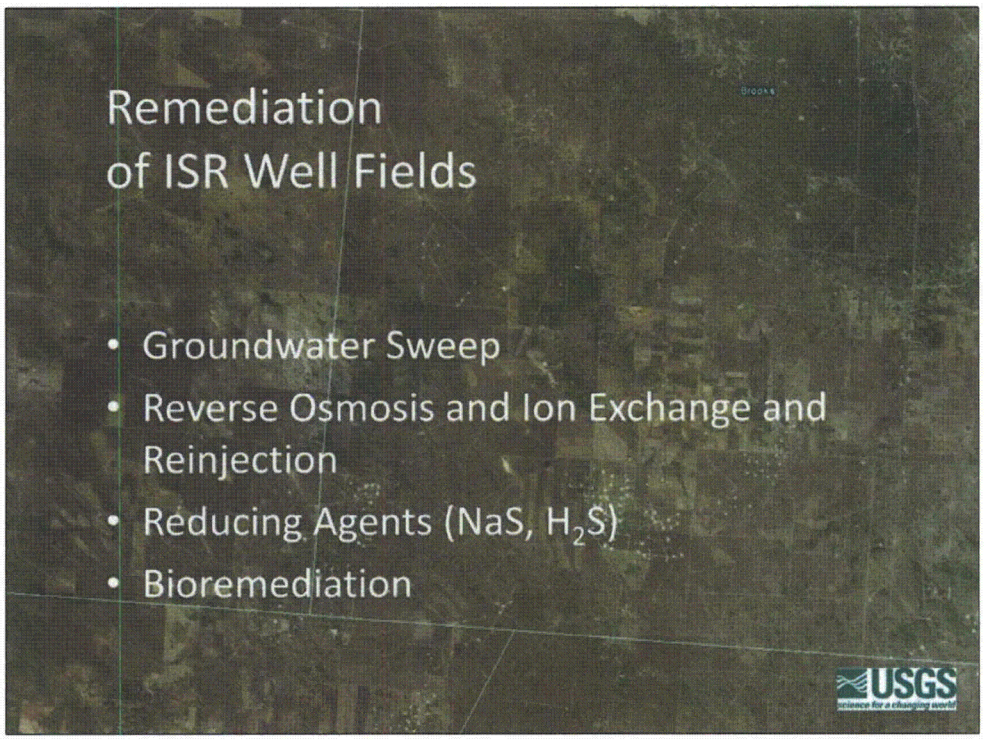


At the Grover, Colorado, pilot test site, pump and treat technologies did not return groundwater to baseline. Analysis of data collected by Colorado State regulators showed upward-trending uranium, beta activity, radium, TDS, calcium, magnesium, specific conductivity, total hardness, gross alpha, and ammonia. Results from individual wells differentiated using solid colored lines are shown above in the time series plot of uranium concentration. Note that the vertical red line indicates the end of the 6-month stabilization period required for Texas PAAs. These increasing concentrations of analytes indicate groundwater may not have stabilized when the Grover well field was released.



During the one-year stabilization period that followed restoration at Mobil's Crown Point, New Mexico ISR pilot project, both upward and downward trends in various chemical constituents were noted (Mobil, 1981). The Crown Point data are not detailed enough to analyze these trends, but the data indicate that groundwater may not have stabilized when the final samples were collected, similar to the Grover, Colorado, project.

Examples from Grover, Colorado, Crown Point, New Mexico, and ISR pilot projects in Wyoming indicate that the 6-month stability period mandated by Texas ISR rules may not have been long enough to adequately determine if groundwater in well fields had stabilized. Recent rule changes in Texas allow for longer term monitoring and could yield valuable data about the chemical stability of groundwater after ISR mining.



Effectiveness of Restoration Techniques

After mining has ceased, a restoration method called groundwater sweep can be used whereby groundwater in a mined aquifer is pumped from the well field either to a deeper aquifer, an adjacent well field where mining is being initiated, or to surface ponds where it is allowed to evaporate. Local groundwater then "sweeps in" to replace the displaced water. This is typically the first method of restoration applied to a well field (Mays, 1994).

Reverse osmosis and ion exchange are methods of removing contaminants from groundwater in well fields. The cleaned water is then reinjected into the well fields (Mays, 1994).

Reducing agents (H, NaS and H_2S) have been added to well-field groundwater in an attempt to return groundwater and host rocks to reducing conditions, thereby reversing the effects of oxidizing mining solutions (lixiviants) within the aquifer.

Bioremediation, the stimulation of native bacteria within the aquifer whose life processes fix metals from solution, is another remediation technique currently receiving much attention (Long and others, 2008).

Table 9: Elements with USEPA and TECQ Primary Maximum Contaminant Levels Restored vs. Baseline for Texas Well Fields With Known Restoration Methods

PAA	Restoration Method	Arsenic	Cadmium	Fluoride	Lead	Mercury	Nitrate-N	Selenium	Radium	Uranium
Hobson - 1	GW Sweep Only	215%	1%	134%	5%	16%	9%	50%	93%	824%
Longoria -1	GW Sweep Only	109%	10000%	98%	1333%	333%	34%	150%	49%	2574%
Longoria - 2	GW Sweep Only	91%	10000%	82%	71%	333%	22%	267%	74%	4892%
McBryde	GW Sweep Only	17%	6%	50%	0%	10%	56%	8%		144%
Average for GW Sweep Only		**108%**	**5002%**	**91%**	**353%**	**173%**	**30%**	**119%**	**72%**	**2109%**
Benavides-4	RO	250%	3333%	77%	87%	100%	3%	250%	74%	48%
Bruni 5-1	RO	56%	2%	143%	4%	11%	15%	55%	66%	257%
Bruni 5-2	RO	33%	4%	155%	7%	11%	22%	68%	97%	655%
O'Hern-4	RO	93%	91%	63%	5%	13%	NR	325%	NR	313%
Average for RO only		**108%**	**858%**	**110%**	**26%**	**34%**	**13%**	**175%**	**79%**	**318%**
El Mesquite-1	RO and Ion Exchange	57%	17%	117%	3%	50%	22%	200%	85%	1062%
El Mesquite-3	RO and Ion Exchange	31%	83%	74%	11%	40%	19%	364%	15%	301%
Holiday -3	RO and Ion Exchange	13%	200%	94%	0%	100%	53%	23%	5%	8%
Average for RO and ion exchange		**34%**	**100%**	**95%**	**5%**	**63%**	**31%**	**196%**	**35%**	**457%**
Brelum -1	GW Sweep and RO	23%	6%	107%	5%	10%	3%	2%	62%	68%
Brelum -2	GW Sweep and RO	23%	1%	97%	7%	11%	5%	100%	200%	42%
O'Hern-2	GW Sweep and RO	24%	5%	53%	1%	0%	55%	20%	34%	33%
Average for GW Sweep and RO		**23%**	**4%**	**86%**	**4%**	**7%**	**21%**	**41%**	**99%**	**48%**
Trevino - 1	Electrodialysis	32%	1%	82%	2%	5%	5%	2%	54%	34%
Trevino - 2a	Electrodialysis	113%	1%	83%	5%	33%	6%	170%	22%	814%
Trevino 2b	Electrodialysis	81%	1%	81%	5%	33%	19%	400%	72%	1944%
Average for Electrodialysis		**75%**	**1%**	**82%**	**4%**	**24%**	**10%**	**191%**	**49%**	**931%**

Pump and Treat Technology

Texas provides a database that can be used to examine the effectiveness of the "pump and treat" technologies of groundwater sweep, reverse osmosis, ion exchange, and electrodialysis. Historically, pump and treat techniques were the only restoration techniques used in ISR mines developed in Texas.

Uranium in groundwater is 2,109 percent of baseline in well fields using groundwater sweep only, yet is 48 percent of baseline when groundwater sweep is combined with reverse osmosis (Table 9). Similar trends are shown for arsenic, cadmium, lead, mercury, and selenium. Trends for fluoride and nitrate are not as clear.

Analysis of patterns in Texas PAAs show restoration using groundwater sweep coupled with reverse osmosis results in the greatest decrease in concentration of chemical constituents. These coupled techniques are commonly used in many well-field restoration projects nationwide.

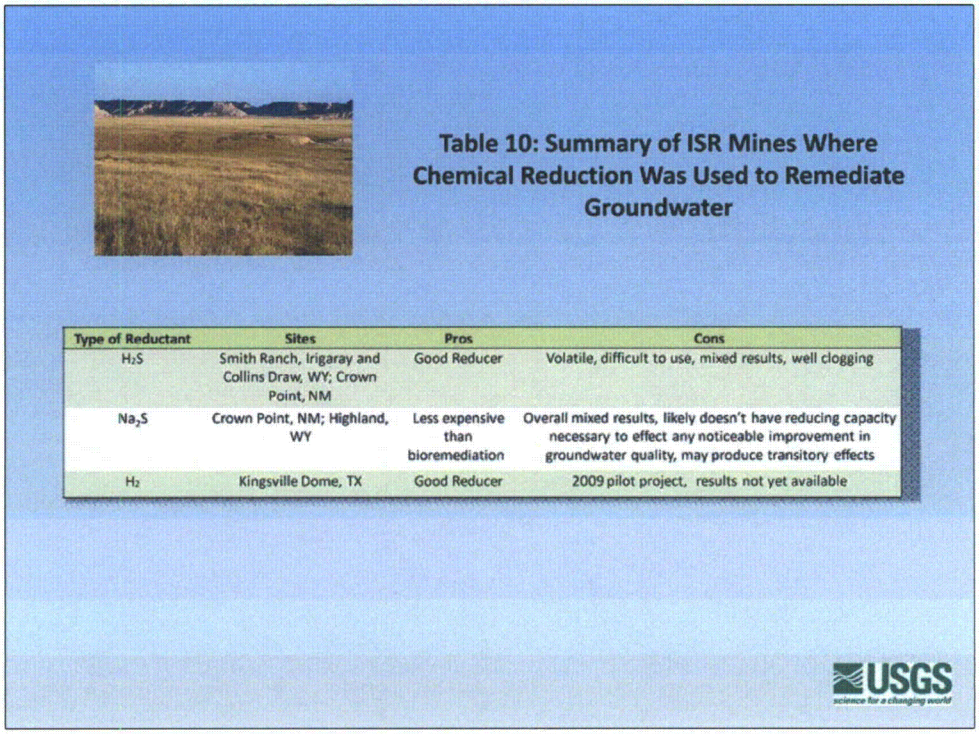


Table 10: Summary of ISR Mines Where Chemical Reduction Was Used to Remediate Groundwater

Type of Reductant	Sites	Pros	Cons
H_2S	Smith Ranch, Irigaray and Collins Draw, WY; Crown Point, NM	Good Reducer	Volatile, difficult to use, mixed results, well clogging
Na_2S	Crown Point, NM; Highland, WY	Less expensive than bioremediation	Overall mixed results, likely doesn't have reducing capacity necessary to effect any noticeable improvement in groundwater quality, may produce transitory effects
H_2	Kingsville Dome, TX	Good Reducer	2009 pilot project, results not yet available

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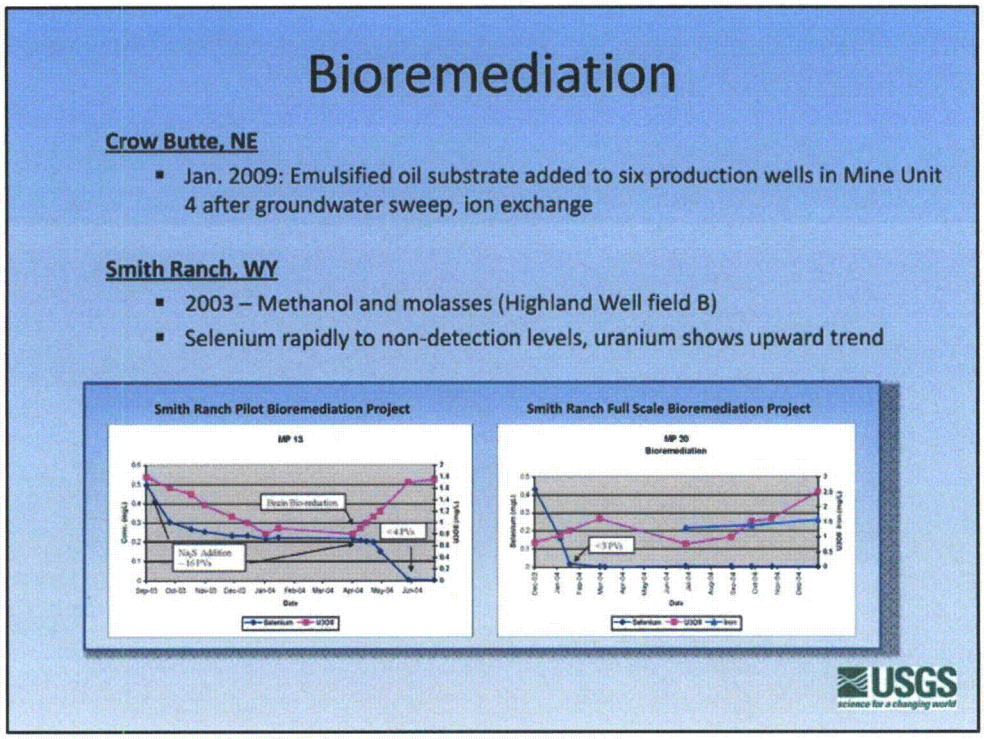
Chemical Reduction

Inorganic chemical reductants are designed to reverse the effects of oxidizing lixiviant solutions on host rock and groundwater. Overall, these techniques when used in remediation of U.S. ISR mines, show mixed results (Table 10). Crown Point and Irigaray did not appear to significantly benefit from the addition of reductants into groundwater at the levels applied (LQD/DEQ Response Document, 2005; Mobil, 1981). Uranium Resources International is completing a pilot project in Texas to test the restoration effectiveness of hydrogen gas in removing analytes from groundwater (M. Pelliza, oral commun., May 2009). Results of this study are not yet available.

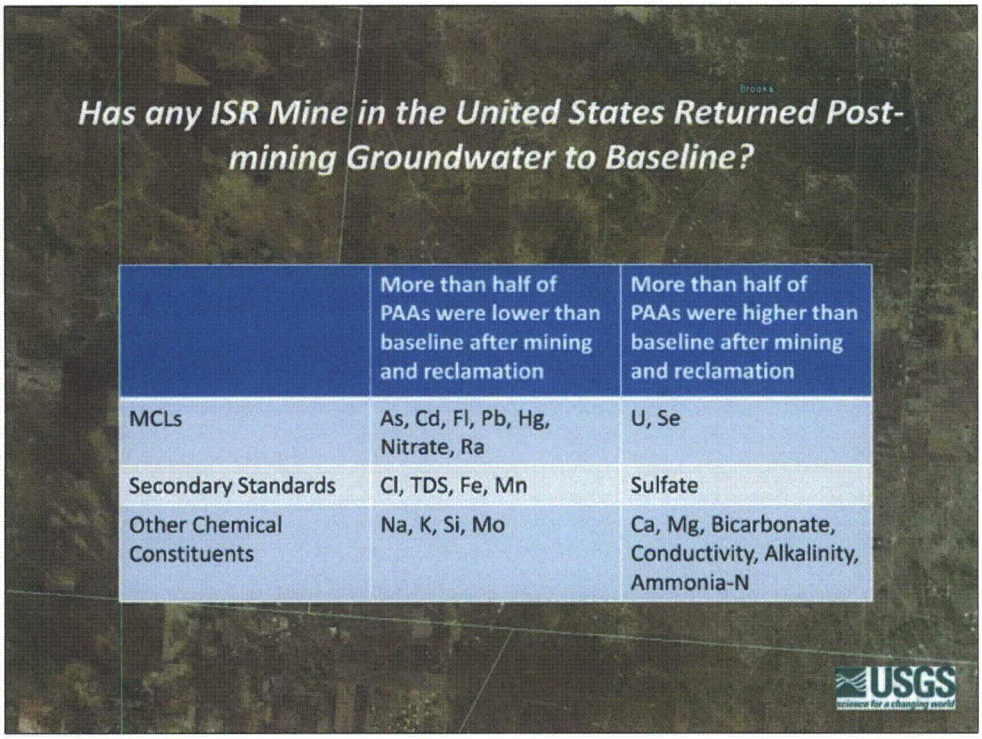


Bioremediation

Nutrients, such as acetate, methanol, and molasses, can be added to groundwater as a food source to stimulate native bacteria populations. As bacteria populations rise in response to increased food, metal concentrations decrease in groundwater; however the exact mechanism is uncertain.

In January 2009, an emulsified oil substrate was added to 6 production wells at the Crow Butte ISR mine as part of remediation of groundwater in Mine Unit 4 (NDEQ, 2009). The first 4 months of preliminary results do not show a significant reduction in uranium. At a Smith Ranch/Highland ISR remediation project in 2003, methanol and molasses were added to wells in the Highland B well field, first as a pilot project following chemical reduction (Na_2S) and then in a full-scale remediation project without prior chemical reduction (Reimann and Huffman, 2005). Selenium in groundwater was rapidly reduced in both the pilot (MP13) and full-scale (MP20) fields, although uranium concentration initially increased (see graphs above). Uranium increases noted in groundwater after bioremediation had been initiated may be attributable to the dissolution of iron oxyhydroxides and the concomitant release of their contained uranium in response to increasingly reducing conditions created during bioremediation (Reimann and Huffman, 2005). In subsequent bioremediation projects at Smith Ranch, cheese whey coupled with methanol has been used as a biostimulant.

The USGS continues to gather and process records from State agencies to track the effectiveness of these bioremediation methods.



Conclusions

Can we answer the question: "Has any ISR mine in the United States returned post-mining groundwater to baseline?"
Answer: Not based upon analysis of the Texas database because "final value" records were found for only 22 of 77 PAAs (13 of 36 mines).

We can conclude that in Texas, ISR mines are characterized by high baseline arsenic, cadmium, lead, selenium, radium, and uranium. After mining and restoration, for those well fields that reported "final values" in TCEQ records, more than half of the PAAs had lowered levels of many elements, including some that dropped below MCL.

Of those elements for which MCL is established, the majority of PAAs showed increases in uranium and selenium after mining and restoration and decreases in arsenic, cadmium, fluoride, lead, mercury, nitrate, and radium to below baseline for the majority of well fields.

Analytes for which secondary standards have been established show that sulfate is the only constituent that increased in the majority of well fields after mining and remediation, whereas chloride, TDS, iron, and manganese decreased. Chemical constituents for which no MCL or secondary standards were set are higher than baseline for calcium, magnesium, bicarbonate, conductivity, alkalinity, and ammonia. Sodium, potassium, silica, and molybdenum were lower than baseline in the majority of well fields after mining and remediation.

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Analysis of Products Used for Drilling

Crosby 25-3 Well – Windsor Energy, Park County, Wyoming

April 2009

INTRODUCTION

The following summaries are based on the possible health effects of the products and chemicals used in drilling a natural gas well, Crosby 25-3, northwest of Clark, Park County, Wyoming. This well was directionally drilled with a total vertical depth of 8,038 feet. Natural gas, petroleum condensate, and drilling fluids were accidentally released from the ground adjacent to the well due to a breach in the surface casing at approximately 255 feet below ground surface. Released fluids and natural gas followed near-vertical bedding planes and/or fractures until they reached the surface at two locations. The release occurred over a period of about 58 hours between August 11 and 13th, 2006 and resulted in surface soil impacts in an area estimated to cover approximately 25,000 square feet.[1]

TEDX compiled a list of 42 products containing 32 chemicals used to drill the Crosby 25-3 Well as of March 2009. Information for the analysis came from Material Safety Data Sheets (MSDS) for the products in use at the time of the blowout, through information provided in the Terracon Remedial Investigation Work Plan – Final Draft, dated July 2, 2007, and information disclosed in the Terracon Remedial Investigation Work Plan – Amended Draft, dated September 14, 2007. TEDX makes no claim that the list of products and chemicals in this analysis is complete.

PRODUCT SUMMARY

Material Safety Data Sheets (MSDSs)

MSDSs are designed to inform those who handle, ship, and use the products about their physical and chemical characteristics, and their direct and/or immediate health effects, in order to prevent injury while working with the products. The sheets are also designed to inform emergency response crews in case of accidents or spills. The total reported composition of a product on an MSDS can be less than 0.1% up to 100%. MSDSs are not submitted to the Occupational Safety and Health Administration (OSHA) for review. The product manufacturers determine what is revealed on their MSDSs.

The health information on MSDSs most often warns of possible harm to the skin and eyes, gastrointestinal and respiratory tracts, followed by the nervous system and brain. Many MSDSs do not address the outcome of long term, intermittent or chronic exposures, or adverse health effects that may not be expressed until years after the exposure.

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[1] Terracon Consulting Engineers & Scientists. 2007 Sep 14. Remedial Investigation Work Plan - Final Draft: Crosby 25-3 Natural Gas Well Release, Road 1AB, Clark, Park County, Wyoming, submitted to Windsor Energy Group, LLC, Oklahoma City, Oklahoma Project No. 26067064.

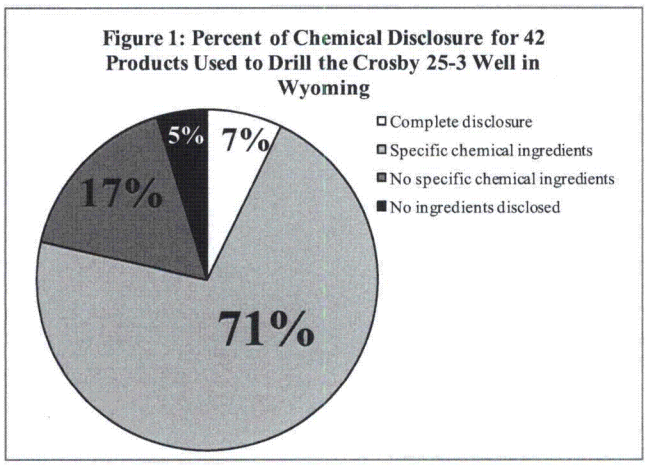
Of the 42 products known to be used to drill the Crosby Well, TEDX has obtained MSDSs for 37 of them. Two of the MSDSs listed "no hazardous ingredients" as the composition of the product. Seven MSDSs listed at least one ingredient, but no CAS numbers[2], and one of these MSDSs provided no percent of composition. Of the 28 MSDSs that listed at least one ingredient with a CAS number, five provided information on less than 50% of the total composition and 20 listed between 51% and 95%. Three MSDSs disclosed over 95% of the product ingredients and all the CAS numbers.

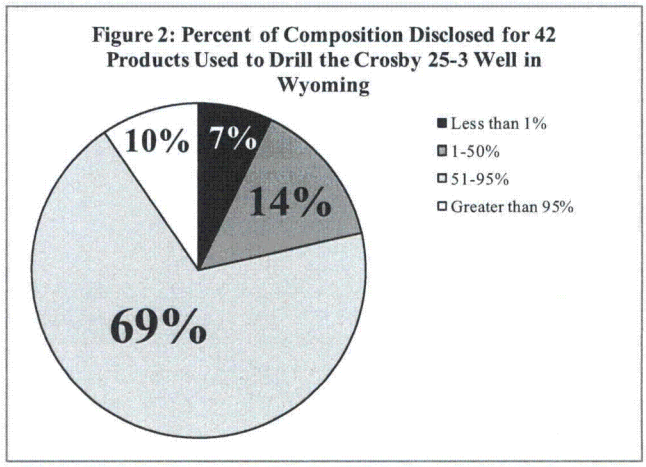
Other Sources of Information

The remaining five products on the TEDX list came from the Terracon reports listed above. The Terracon reports list a single chemical in each of the products. Information on the composition ranges from 10 to 30% and 60-100%, but no product in these reports provides complete information on the specific chemical makeup for 100% of the composition.

Evaluation of the information available about the 42 products

Thirty products (71%) list specific chemical ingredients (Figure 1). Seven (17%) contain chemicals with only general or non-specific names and no information for two (5%) of the products was provided. The remaining 3 (7%) of the products disclose all of the ingredients.



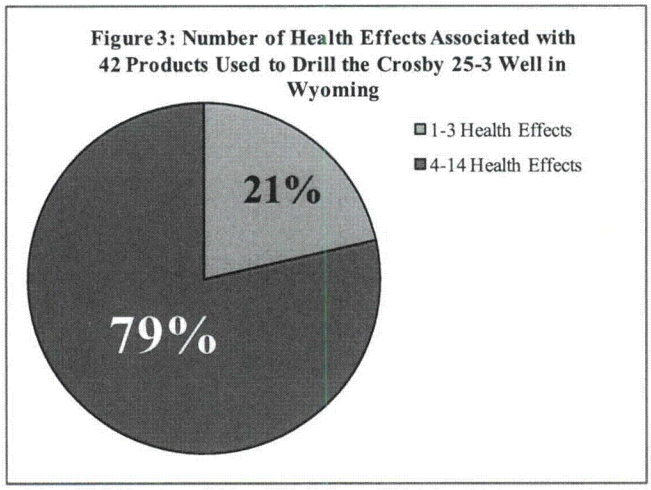


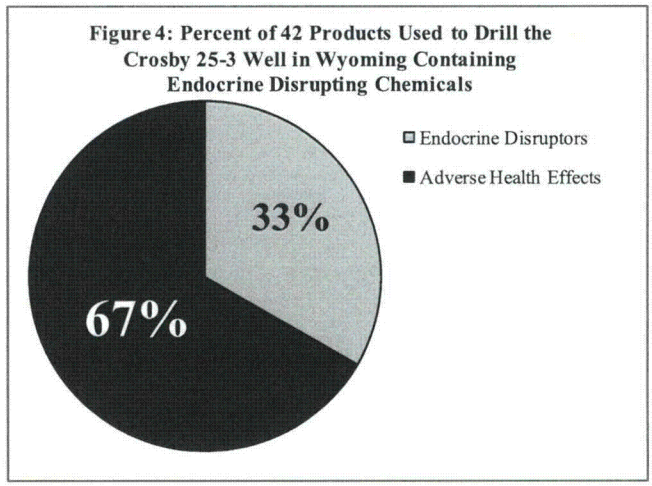
Less than 1% of the total composition is known for 3 (7%) of the 42 products used to drill the Crosby Well (Figure 2). Less than 50% of the composition is known for 6 (14%) of the products, and between 51% and 95% of the composition is known for 29 (69%) of the products. Four (10%) of the products have information about more than 95% of their full composition.

Evaluation of the health effects associated with the 42 products

All of the products on TEDX's list are associated with adverse health effects, even though two of the MSDSs stated that they contained no hazardous ingredients. Twenty-one percent had one to three associated health effects, and 79% had 4-14 health effects (Figure 3). Thirty-three percent of the products contained one or more chemicals considered to be endocrine disruptors (Figure 4), chemicals that interfere with development and function.

[2] CAS =Chemical Abstracts Service, provided by the American Chemical Society. This unique number is used to identify a specific substance. A single substance can have many different names, but only one CAS number. A substance may be a single chemical, an isomer of a chemical, a mixture of isomers, polymer, biological sequences, or a mixture of related chemicals.





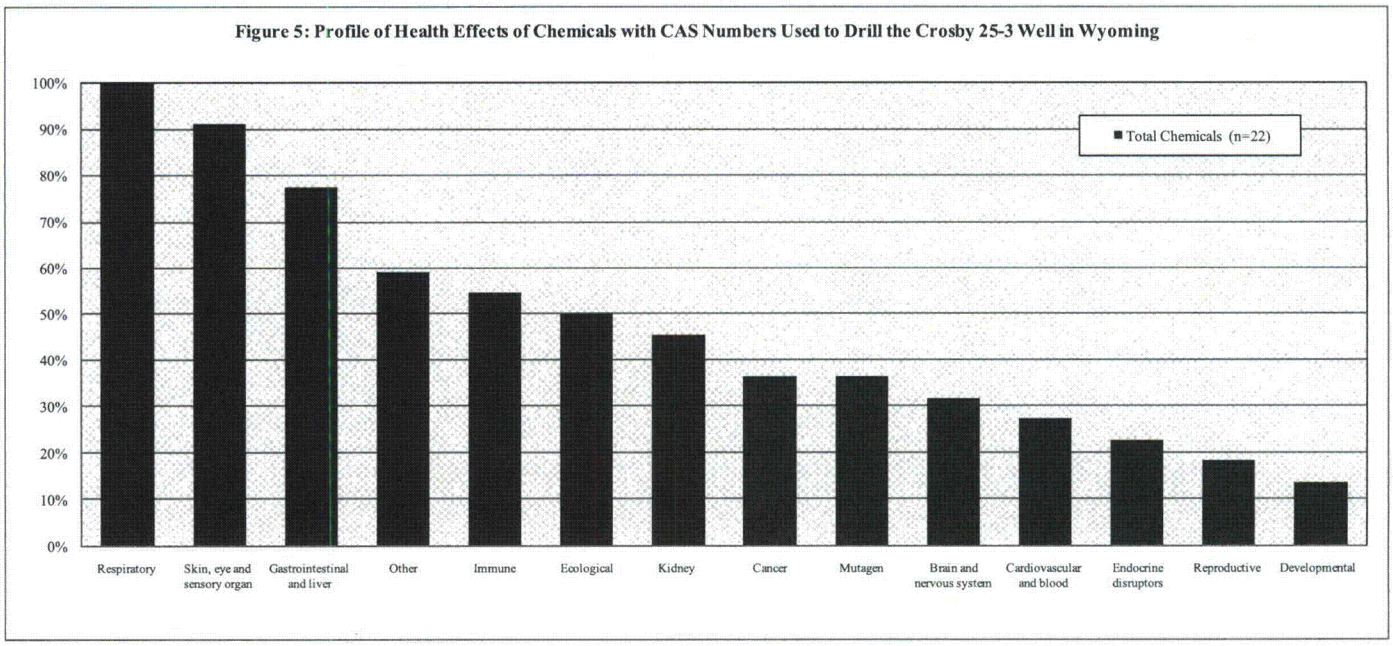
CHEMICAL SUMMARY

Evaluation of the information available about the 32 chemicals

Products may contain more than one chemical, and a given chemical may occur in more than one product. In the 42 products identified above, there were a total of 32 chemicals. Specific chemical names and CAS numbers could not be determined for 10 (31%) of the chemicals on TEDX's list. The names provided were too general (e.g. cellulose derivative, inert material), or they were listed as "mixtures," or "no hazardous ingredients/substances." It was impossible to link these 10 chemicals without CAS numbers to any health category aside from the health data reported on an MSDS. The limitations of MSDS data for possible health effects are noted above.

Summary of the health effects associated with the 22 chemicals with CAS numbers

Figure 5 shows the percentages of the 22 chemicals with CAS numbers associated with the general health categories used in government reports. Chemicals are often included in more than one category.

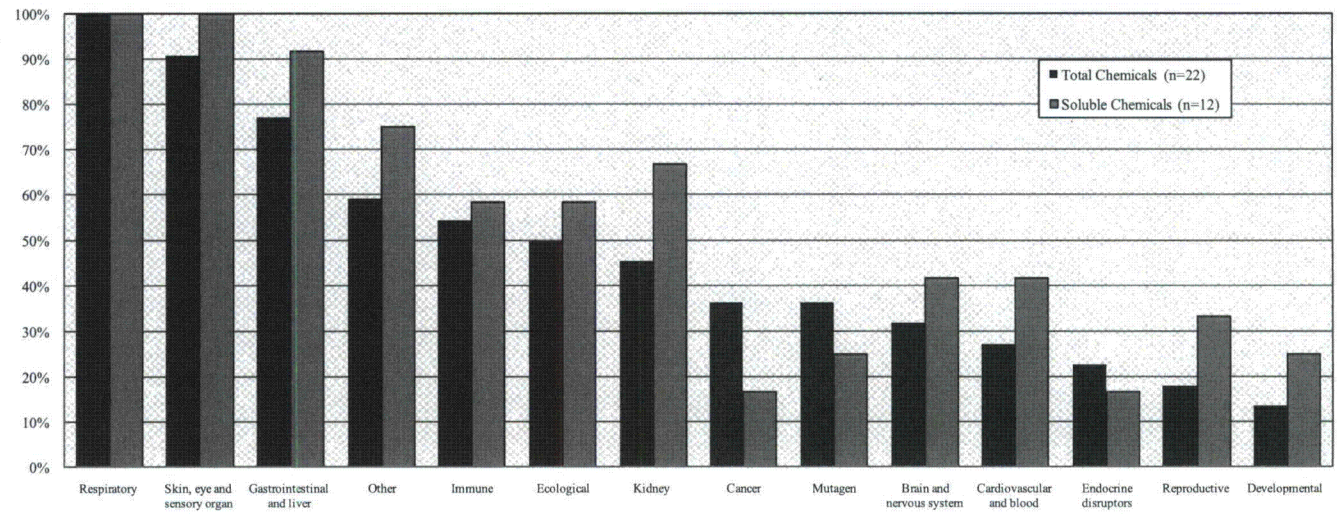


When all of the chemicals are combined, 100% are associated with respiratory effects. Over 90% cause skin, eye and sensory organ problems, and 77% are associated with damage to the gastrointestinal system or liver. The immune system damage can result from exposure to 55% of the chemicals and 50% can cause ecological

effects (harm to aquatic species, birds, amphibians or invertebrates). Fifty-nine percent of the chemicals have health effects in the 'Other' category. The 'Other' category includes such effects as changes in weight gain, or effects on teeth or bones, for example, but the most often cited effect in this category is the ability of the chemical to cause death.

The health effects on the left side of the figure are those effects that are more likely to appear immediately or soon after exposure. These effects include symptoms such as burning eyes, rashes, coughs, nausea, vomiting and diarrhea. The health effects on the right side of the figure are long term and would tend to appear months or years later, such as some cancers, the results of organ damage, harm to the reproductive system, or developmental effects as the result of prenatal exposure, all of which were associated with over 10% of the chemicals in this analysis.

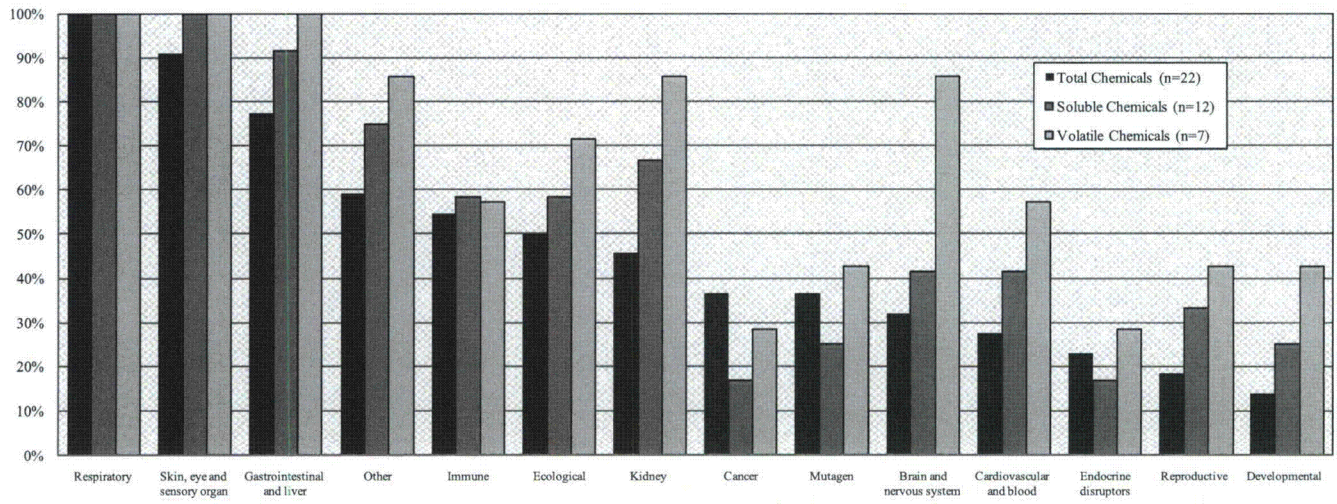
Figure 6: Profile of Health Effects of Soluble Chemicals with CAS Numbers Used to Drill the Crosby 25-3 Well in Wyoming



Twelve (54%) of the chemicals with CAS numbers are water soluble. When examined alone (Figure 6), they produce a similar profile of health effects as all the chemicals combined, but with higher percentages in every category except Cancer, Mutagen and Endocrine disruptors. Notably, 100% of these chemicals can harm the respiratory system and the skin, eyes and sensory organs.

Seven (32%) of the chemicals are volatile (Figure 7), in other words, they can become airborne. All of these chemicals can harm the respiratory system, the skin, eyes or sensory organs, and the gastrointestinal system or liver. Over 80% of the volatile chemicals harm the kidneys, the brain and nervous system, or have 'other' effects. Overall, the volatile chemicals produce a different profile with higher percentages than the water soluble chemicals. Because they can readily become airborne and can be inhaled as well as swallowed, and they can reach the skin, the potential for exposure to these chemicals is greater.

Figure 7: Profile of Health Effects of Volatile & Soluble Chemicals with CAS Numbers Used to Drill the Crosby 25-3 Well in Wyoming



COMMENTS

The health effects summary for the chemicals used in Crosby Well is not a weighted analysis. Each chemical is included only once in the summary whether it is in only one product, or in many. Some of the most prevalent chemicals are among those associated with the most health categories.

The products used to drill this Wyoming well eventually made their way to the surface because of an accident. However, most drilling fluids are deliberately brought back to the surface during the drilling process and either reused in a closed loop system, or deposited into pits on the pad for later disposal. Each drilling event is custom-designed depending on the geology, depth, and resources available. The products and chemicals used, and the amounts or volumes used, therefore can differ from well to well.

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Products and Chemicals Used in Fracturing
February 2009

TEDX (The Endocrine Disruption Exchange) has compiled a list of the names of products and their chemical constituents reportedly used during the fracturing of natural gas wells. Nalco[1], World Oil[2] and J.D. Arthur [3] list the functional categories of these chemicals as follows:

- acids
- biocides
- breakers
- clay stabilizers
- corrosion inhibitors
- crosslinkers
- defoamers
- emulsifiers
- fluid loss control
- foamers
- friction reducers
- gellants
- iron control
- non-emulsifiers
- pH control
- polymers
- pseudo-polymers
- proppants
- resins
- sand
- scale control
- solvents
- surfactants
- viscosifiers

TEDX's list includes the names of 435 fracturing products containing 344 chemicals as of February 2009. Information about the products and the chemicals they contain came from several states and a variety of sources including Material Data Safety Sheets (MSDSs), state Emergency Planning and Community Right-to-Know Act (EPCRA) Tier II reports, Environmental Impact Statement and Environmental Assessment Statement disclosures, rule-making documents, and from accident and spill reports, etc. The quantity and quality of information varied among these data sources. TEDX makes no claim that the following information is complete either in the scope of the products used during fracturing operations, or in the chemical composition of the products.

PRODUCT ANALYSIS

Material Safety Data Sheets (MSDSs)

MSDSs are designed to inform those who handle, ship, and use the product(s) about their physical and chemical characteristics, and their direct and/or immediate health effects in order to prevent injury while working with the product. The sheets are also designed to inform emergency response crews in case of accidents or spills. The total reported composition of a product on an MSDS can be less than 0.1% up to 100%. The health information on MSDSs most often warns of possible harm to the skin and eyes, gastrointestinal and respiratory tracts, followed by the nervous system and brain. Many MSDSs do not address the outcome of long term, intermittent, or chronic exposures, or adverse health effects that may not be expressed until years after the exposure. MSDSs are not submitted to the Occupational Safety and Health Administration (OSHA) for review. The product manufacturers determine what is revealed on their MSDSs.

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[1] List of fracturing products from Nalco, Upstream Petroleum/Natural Gas: Fracturing Additives, http://www.nalco.com/asp/industries_served/upstream_petroleum/drilling/fracturing.asp, Accessed on 11-24-08.

[2] World Oil, Fracturing products and additives – hydraulic fracturing of oil wells – Fracturing: A Well Completion Reference, http://findarticles.com/p/articles/mi_m3159/is_/ai_21219369, Accessed on 11-24-08.

[3] Arthur J.D., Bohm B., Coughlin B.J., Layne M. Evaluating the environmental implications of hydraulic fracturing in shale gas reservoirs. International Petroleum & Biofuels Environmental Conference, Albuquerque, NM. Nov 11-13, 2008.

Of the 435 products on TEDX's list, 282 had an MSDS. Three of the MSDSs listed no ingredients, and 10 reported only "no hazardous ingredients" or "particulates not otherwise classified (PNOC)." Thirty-seven MSDSs listed at least one ingredient, but no CAS numbers[4], and 19 of these MSDSs provided no percent of composition. Among the 232 MSDSs that listed at least one ingredient with a CAS number, 75 provided information on less than 50% of the total composition. Thirty-two MSDSs disclosed over 95% of the product ingredients and all the CAS numbers.

State Tier II Reports

Information for 91 of the 435 products on the TEDX spreadsheet came from Tier II report data. Tier II reports must be filed by storage facilities under EPCRA. The Act sets a minimum amount above which a product containing a hazardous substance has to be reported in a storage facility. Reporting requirements vary from state to state, and the amount of information included on the form also varies from county to county and company to company. The descriptors on the forms received by TEDX ranged from a functional category name (e.g. surfactants, gellants, etc.) with no product name or no other chemical information, to the name of the product with specific chemical ingredients and CAS numbers. The percent of the total composition of the products is rarely included on these forms.

Thirteen of the products listed on Tier II forms did not provide any ingredients, while 68 listed one chemical. Ten products listed more than one ingredient, and three of these listed at least one unidentifiable (general) chemical name with no CAS number.

Other Sources of Information

The remaining 62 products on the TEDX list came from a variety of sources mentioned above, with varying amounts of information, ranging from no information about product composition (12), to general chemical class name(s) (11), to at least one specific chemical name (39). The source of information on only two products in this category provided complete information on the specific chemical makeup and over 95% of the composition.

Evaluation of the information available about the 435 products

Two hundred and seventy-three products (63%) have at least one chemical ingredient listed with a CAS number (Figure 1). Twelve percent of the products contain a combination of chemicals with and without CAS numbers, and 11% contain chemicals with only general or non-specific names. No information for 9% of the products was provided. The remaining 5% of the products disclose all of the ingredients.

Figure 1: Percent of Chemical Disclosure for 435 Products Used in Natural Gas Fracturing

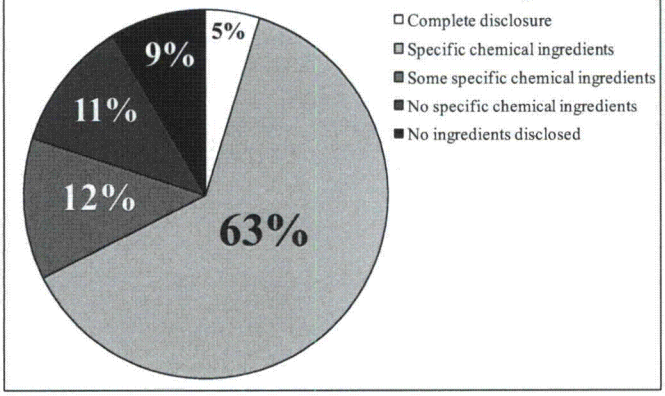
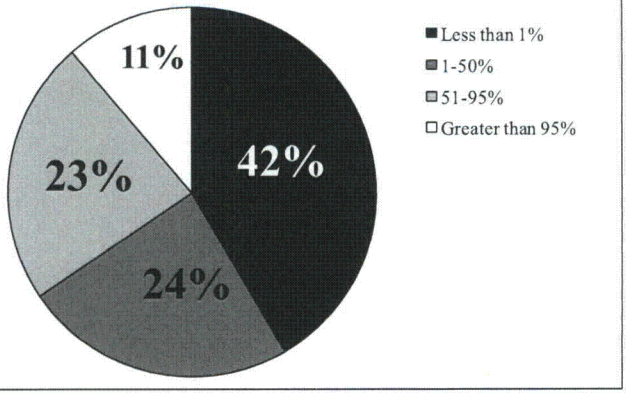


Figure 2: Percent of Composition Disclosed for 435 Products Used in Natural Gas Fracturing



[4] Chemical Abstracts Service number. This number is used to identify a specific chemical. A single chemical can have many different names, but only one CAS number.

Less than 1% of the total composition is known for 181 (42%) of the 435 fracturing products (Figure 2). Less than 50% of the composition is known for 24% of the products, and between 51% and 95% of the composition is known for 101 (23%) of the products. Eleven percent (49) of the products had information about more than 95% of their full composition.

CHEMICAL ANALYSIS

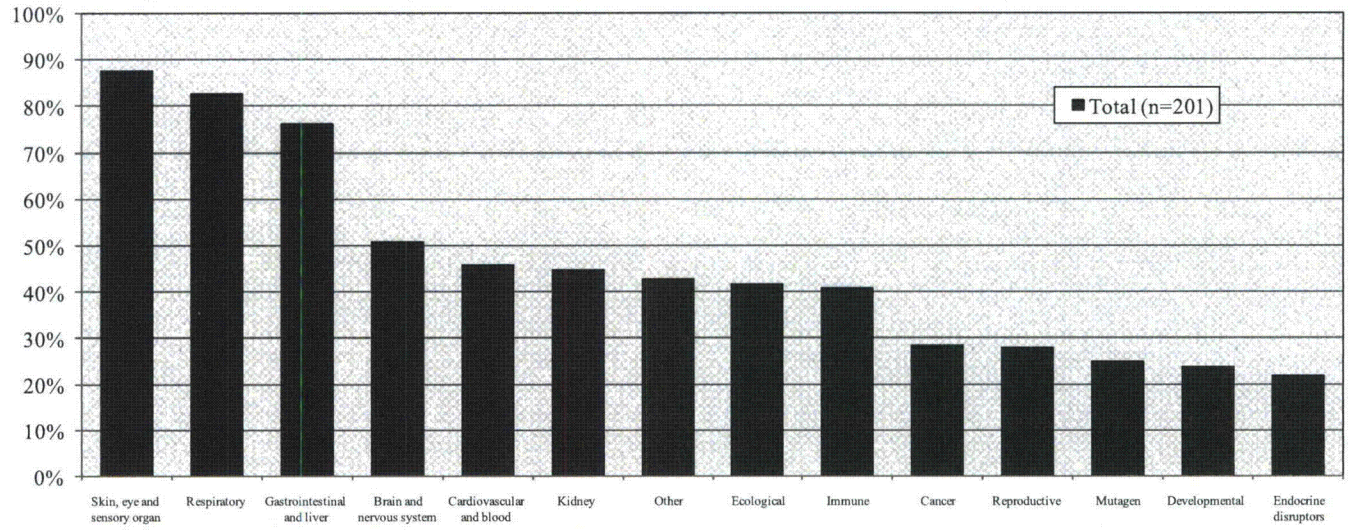
Evaluation of the information available about the 344 chemicals

Specific chemical names and chemical identification numbers (CAS numbers) could not be determined for 143 (42%) of the 344 chemicals on TEDX's list. The names of these chemicals were too general (e.g. latex base, surfactant, or polymer, etc.), or they were listed as "proprietary," "mixtures," "unspecified," "various," or "no hazardous ingredient."

For 56 of the 143 chemicals with no CAS number, it was impossible to link those chemicals to any health category aside from the health data reported on an MSDS if one was available. The limitations of MSDS data for possible health effects are noted above. Some health data was provided for another 8 chemicals, but for the remaining 79, no information could be found.

Figure 3 shows the percentages of the 201 chemicals with CAS numbers, which affect the general health categories used in government reports.

Figure 3: Profile of Fracturing Chemicals with CAS Numbers Associated with Generally Accepted Health Categories



FOR FURTHER CONSIDERATION

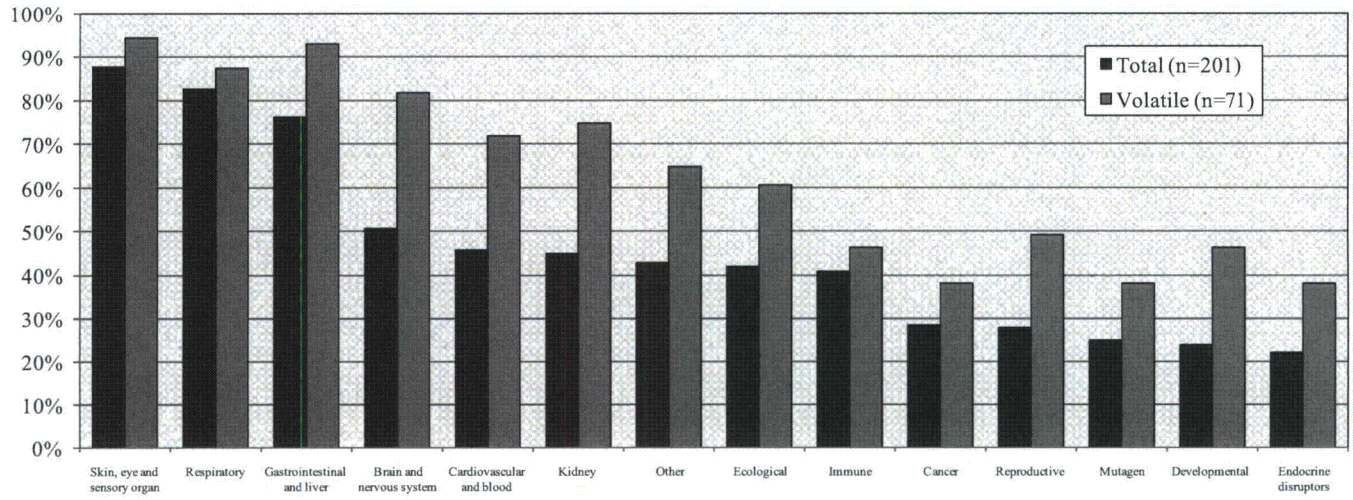
- Full information about ingredients and composition was available for only 5% (21) of the 435 products on TEDX's list (Fig. 1). The identity of every chemical and how much of each is present in the container is needed to determine product safety. It is also necessary to know the exact chemical composition of the vehicle used to dissolve or suspend the chemical(s) and used to fill the product container to the brim.

- Twelve of the 21 products providing their complete formulation contained only one ingredient, such as starches, cellulose, or carbon, relatively harmless ingredients compared with other chemicals on the list.

- Air is the primary pathway of concern for fracturing chemicals. Ninety-six percent (281) of MSDSs provide a warning about eye and/or skin harm, 94% warn about respiratory system harm, and 49% warn about brain or neurological harm based primarily on inhalation and/or dermal contact.

- Sixty-five percent of the volatile chemicals for which TEDX has CAS numbers are associated with eight or more of the 14 generally accepted health categories used in government reports. Ninety-four percent are associated with skin, eye and respiratory harm, 93% with harm to the gastrointestinal system, 87% with respiratory system damage, and 83% with brain and nervous system effects (see Figure 4).

Figure 4: Profile of Fracturing Chemicals with CAS Numbers Associated with Generally Accepted Health Categories



- Numerous products with ingredients that would ordinarily be considered benign have MSDSs that warn of the irritant nature of the chemical to the eyes, skin, and respiratory tract. In many instances these chemicals exist as fines or dusts.

- Gas field workers are most likely to be the first exposed to the chemicals used in fracturing, especially to air- borne fines, dusts and volatile compounds. As the chemicals disperse from the pad, those living in proximity to fracturing operations will also be exposed.

- A health monitoring program for gas field workers and near-by residents could now be established based on the consistent profile of health categories associated with chemicals used during natural gas operations.

- For reasons stated above, the list TEDX has complied is limited. It still provides a glimpse of the kinds of materials that are being introduced into the environment where natural gas operations are taking place. It also demonstrates the need for full disclosure of the formulation of the fracturing fluid used at each stage and event. This would include the amount of each product used, and the total amount of all fluids. This information would provide a better estimate of the contents of what will be recovered and the concentrations of the chemicals in the waste streams above and below ground.

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Potential Health Effects of Residues in 6 New Mexico Oil and Gas Drilling Reserve Pits Based on Compounds Detected in at Least One Sample Revised November 15, 2007

List of Substances Detected

The following substances were detected in six drilling reserve pits in the San Juan Basin of northwestern New Mexico and the Permian Basin of southeast New Mexico. An industry committee comprised of 19 oil and gas companies that operate in New Mexico sponsored a sampling and analysis program (SAP) of pit solids. The SAP was completed by a third party consultant and analytical laboratory. The SAP focused on drilling/reserve pits prior to closure.

This list was amended on November 15, 2007 after discovering that the laboratory doing the analysis admitted it purposefully added nine chemicals (listed below) to the samples prior to testing. This amended document is a reanalysis of the chemicals in the reserve pits excluding those added by industry.

1,2,4-Trimethylbenzene	Iron	Uranium
1,3,5-Trimethylbenzene	Isopropylbenzene	Zinc
1-Methylnaphthalene	Lead	Oil and Grease
2-Butanone	m+p-Xylene	Radium 226
2-Methylnaphthalene	Manganese	Radium 228
3+4 Methylphenol	Mercury	Chloride
Acetone	Methylene chloride	Sulfate
Arsenic	Naphthalene	
Barium	N-Butylbenzene	
Benzene	N-Propylbenzene	
Benzo(a)pyrene	O-xylene	**Substances eliminated**
Cadmium	Pentachlorophenol	*Dibromofluoromethane*
Carbon disulfide	Phenol	*2-Fluorophenol*
Chromium	P-Isopropyltoluene	*2,3,4-Trifluorotoluene*
Copper	Sec-butylbenzene	*2,4,6-Tribromophenol*
Cyanide, total	Selenium	*2-Fluorobiphenyl*
Diesel range organics	Silver	*4-Bromofluorobenzene*
Ethylbenzene	Tert-butylbenzene	*Decachlorobiphenyl*
Fluoride	Tetrachloroethene	*O-Terphenyl*
Gasoline range organics	Toluene	*Tetrachloro-m-xylene*

Possible health effects associated with the 42 substances detected in 6 New Mexico drilling reserve pits

Percentage	Number	Effect
100%	42	gastrointestinal and liver toxicants
95%	40	respiratory toxicants
90%	38	neurotoxicants
88%	37	skin and sensory organ toxicants
79%	33	cardiovascular and blood toxicants
79%	33	kidney toxicants
69%	29	developmental toxicants
69%	29	reproductive toxicants
60%	25	result in other disorders
57%	24	immunotoxicants
57%	24	wildlife toxicants
50%	21	endocrine disruptors
48%	20	carcinogens
31%	13	mutagens

Possible health effects associated with 24 (57%) volatile substances in 6 drilling reserve pits in New Mexico:

Percentage	Number	Effect
100%	24	gastrointestinal and liver toxicants
96%	23	respiratory toxicants
96%	23	skin and sensory organ toxicants
92%	22	neurotoxicants
83%	20	kidney toxicants
79%	19	cardiovascular and blood toxicants
79%	19	developmental toxicants
75%	18	wildlife toxicants
75%	18	result in other disorders
67%	16	reproductive toxicants
63%	15	immunotoxicants
54%	13	carcinogens
54%	13	endocrine disruptors
42%	10	mutagens

Possible health effects associated with 4 (10%) soluble substances in 6 New Mexico drilling reserve pits

Percentage	Number	Effect
100%	4	cardiovascular and blood toxicants
100%	4	gastrointestinal and liver toxicants
100%	4	kidney toxicants
100%	4	neurotoxicants
100%	4	reproductive toxicants
100%	4	respiratory toxicants
100%	4	skin and sensory organ toxicants
75%	3	developmental toxicants
75%	3	endocrine disruptors
75%	3	wildlife toxicants
75%	3	result in other disorders
50%	2	carcinogens
50%	2	mutagens
50%	2	immunotoxicants